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TABLE OF CONTENTS

	PAGE
DISEASES OF WILD LIFE TRANSMISSIBLE TO MAN..... <i>K. F. Meyer</i>	203
✓A SURVEY OF THE DESTRUCTIVENESS OF SARDINE NETS USED IN THE MONTEREY REGION..... <i>J. B. Phillips</i>	208
✓RELATIVE DESTRUCTIVENESS OF SARDINE CIRCLE NETS IN SOUTH- ERN CALIFORNIA..... <i>G. H. Clark</i>	219
PARASITISM OF THE CALIFORNIA VALLEY QUAIL BY HAEMOPRO- TEUS LOPTHORTYX, A PROTOZOAN BLOOD PARASITE.... <i>E. C. O'Roke</i>	223
FISHWAYS IN CALIFORNIA..... <i>John Spencer</i>	239
✓BARGE FISHING, A SOUTHERN CALIFORNIA SPORT... <i>Donald H. Fry, Jr.</i>	244
DEER MEAT INVESTIGATION..... <i>H. W. Estill</i>	249
THE CRUISE OF THE "MAYFLOWER"..... <i>Coburn F. Maddox</i>	251
EDITORIALS.....	254
LIFE HISTORY NOTES.....	257
COMMERCIAL FISHERY NOTES.....	260
DIVISION ACTIVITIES.....	263
REPORTS—	
Violations of Fish and Game Laws.....	270
Statement of Expenditures.....	272
Statement of Income.....	275
Fishery Products, January, February and March, 1932.....	276

DISEASES OF WILD ANIMALS TRANSMISSIBLE TO MAN

By K. F. MEYER, University of California

THE KNOWLEDGE that diseased wild animals play an important rôle in the realm of public health is not generally recognized. It is believed that wild animals possess a high standard of health which is continuously maintained by the action of natural selection. While it is true that animals are normally much more healthy than human

beings, and that the weaklings are weeded out by the natural enemies of the species or the severity of the environmental factors, they are not free from epidemic disease. In fact inquiries instituted by various agencies have shown that there exist a number of unstudied epidemic diseases in wild species with which man and his domestic animals are daily in contact directly and indirectly. It is not unlikely that a study of these epidemics offers a possibility of tracing some of the epidemic maladies of man to reservoirs in the wild species. That the animal kingdom may be a source of discomfort, distress, sickness and death has only been appreciated in recent epochs. In the past, empirical experience guided man in avoiding the harmful and destructive effect of animals. Today scientific knowledge is required in order to break the chain of transmission from animals to man. Preventive measures can only be instituted provided detailed information concerning the cause and the course of the epidemic in the animals is known. There is some evidence that by continuous observation one may forecast with some degree of accuracy the outbreaks of wild animal plagues. This is a great advantage since it is very seldom possible to predict a strictly human epidemic. Furthermore, medical science has benefited tremendously by studying epidemics in animals. Attention is here directed to the fundamental contributions made by *Topley, Webster*, and others (See *Science*, 1932, Vol. 75, p. 445), who have diligently analyzed the progress of an infectious disease in experimentally created mouse villages.

As already intimated, little is as yet known concerning the epidemics, except in the cases of tularemia, plague, rocky mountain spotted fever, etc. A brief review of the essential facts may be of general interest.

Tularemia, also known as rabbit fever or deer fly fever, is probably not a "new disease," but it has without a doubt existed unrecognized for a long period of time. California has played a conspicuous part in this disease, for not only was the causative organism, the *Bacterium tularense*, discovered in 1911 by McCoy and Chapin in Tulare County, from which it takes its name, but the first known human case occurred in National City, San Diego County, as long ago as 1904. Only quite recently was this fact established. Dr. T. F. Johnson, for many years health officer of National City, stated in a letter to Dr. Edward Francis, of the United States Public Health Service, that his son contracted tularemia as a boy, 15 years of age, when hunting and dressing rabbits in May, 1904. The blood serum still agglutinated *Bact. tularense* when tested in June, 1928, or 24 years after his illness. Between 1904 and 1928 only three laboratory infections at San Francisco and Los Angeles, and two cases due to handling jack rabbits in the vicinity of Sacramento, were reported. Early in June of 1928, the game deputies in the Alturas region and near the Nevada border reported an enormous mortality among the jack rabbits. Unfortunately suitable specimens for examination were not secured. But the simultaneous appearance in August of six cases of tularemia in laborers stationed in the Alturas district and subsequently treated in the Southern Pacific Hospital at San Francisco, left no doubt that the rabbit disease was tularemia. As an aftermath of this intensive distribution of the rabbit infection which was ushered in by an extensive mortality among the rabbits in Oregon and Idaho, as early as 1926, the incidence of human tularemia was 16 cases in 1928

and 15 in 1929. Of the 58 proved infections, 36 were caused through handling rabbits, 15 followed the bite of the deer fly and woodtick. While the wild rabbit and hare contribute the important reservoir of infection for other animals and man, recent reports of new animal hosts and transmitters such as woodchucks, opossum, muskrat, water rat, sheep, and perhaps quail and a new vector (the California woodtick) indicate the ever widening spread of the infection to other forms of animal and insect life. This situation is almost certain to result in the perpetuation of the disease among lower animal forms and thus increase the possibilities for the development of the infection in human beings. Annually, 500 cases, with a mortality of close to 5 per cent, represent the tribute which the people of the United States pay to the tularemia infested woodtick and its temporary host, the wild rabbit.

In Idaho and Montana tularemia is transmitted to sheep, sometimes causing heavy losses amounting to over 5 per cent of the affected bands.

Those who rarely if ever come in contact with bubonic or pneumonic plague can not appreciate the feeling of uneasiness which must prevail in a territory where this disease exists in the rodents. As a sequel of the great pandemic which originated in the city of Canton and in Hong-kong, the American continent was invaded by plague late in 1899. First seen in San Francisco's famous Chinatown, it extended over four years, but finally vanished only to reappear in 1907. It is not unlikely that chronic plague persisted in the rats and after the fire an extensive migration set in which scattered the diseased rodents. However, it is not unlikely that the rats became infected from the ground squirrels. It is now known that in 1900 epidemics of plague existed among the squirrel population of the San Francisco East Bay counties. Investigations have repeatedly shown that ground squirrels and rats occupy the same burrows and that exchange of ecto-parasites such as fleas is quite common. The general belief that plague was originally brought to the California coast by rats on ships which docked in the Sacramento River, and that these rodents escaped to the mainland and thus spread the plague virus to the ground squirrels, is in all probability correct. Gradually plague as an epidemic disease of rodents has spread south until every county bordering the Pacific, from the Sacramento River to Los Angeles County, has yielded in the course of various surveys a variable percentage of infected ground squirrels. At periodic cyclical intervals extensive epidemics of plague reduce the squirrel and rat population of certain areas. Observations in California indicate that human cases of plague, whether bubonic or pneumonic in character, are invariably preceded by such epidemics among the rodents.

The danger from infected squirrels is twofold: they convey their disease accidentally to man (1) by contact, usually while being skinned or dressed, and (2) through ecto-parasites. The first is preventable by educating the hunters to beware of sick squirrels. The procedures to reduce the chances from the second source can not be outlined until the factors which are operative are better understood. The California ground squirrel is infested by two species of fleas which can carry the plague bacillus. Whether or not in rural districts where no infected rats are found plague is transmitted to them solely through the instrumentality of these fleas, remains to be determined. The rôle of passive wild animal carriers of fleas from the ground squirrel nests or burrows

to the human habitations must be studied. Moreover, until one has investigated the factors which lead to the periodic plague epidemics among the rodents, which are probably much more effective than all eradivative measures, the problem of plague in California remains an important field for research.

Quite recently attention has been called to a new human disease, relapsing fever, in which rodents are apparently involved. Since 1921 sporadic cases of relapsing fever or Spirochaetosis have been diagnosed in people who had camped in widely separated areas of the Eastern California mountain ranges at an altitude of above 5000 feet. Nothing definite is known concerning the mode of transmission. By analogy with similar relapsing fever infections in Texas a tick is suspected as the vector of the parasite. However, in view of the brilliant studies of the Tunisian workers, Nicolle and Anderson, who had shown that the spiral parasites commenced as parasites of small mammals and that burrowing rodents serve as reservoirs of the disease, an inquiry in this particular direction was instituted. Preliminary blood examinations of a number of animals in 1931 incriminated the squirrels as possible carriers of the spirochaetes. Early in 1932, Miss D. Becks of the State Department of Public Health obtained conclusive proof that quite a percentage of chipmunks examined in the mountain regions of Southern California are heavily infected with the parasite of relapsing fever long before ticks have made their appearance. Obviously these rodents serve as potential reservoirs which bring the infection and the transmitting insect close to the human habitations. Again an endless chain of questions must be answered by further investigations.

Rocky Mountain spotted fever is dreaded in the sections in which it is endemic. The mental worry prevents many people from enjoying the opportunities for outdoor life and far outweighs the economic loss due to the actual occurrence of human infections. The prevalence of the malady among those concerned with range management frequently presents a real problem for wool growers. Rocky Mountain spotted fever is primarily an infection of rodents and certain small carnivores, while human infection is accidental. The two-host ticks (wood tick) which are concerned in the transmission of the parasite—a rickettsia—among the ground squirrels, chipmunks, rabbits, or prairie dogs, have complicated life cycles; the successive stages of the insect feed on separate hosts over a period of two years. The control of the disease by means of tick eradication has been found impractical. However, the painstaking studies of Spencer and Parker of the United States Public Health Service climaxed in the preparation of a prophylactic vaccine which has yielded very promising results. More than 4000 persons have been inoculated. The results suggest that the vaccine confers full protection against the milder types of the disease, and ensures the recovery of those who are attacked by the virulent type which occurs in the notorious Bitter Root Valley of Montana.

Since 1926 evidence has been furnished by Maxey and others that endemic typhus fever observed in the eastern and southern United States must be associated with a reservoir in rodents. The origin of some of the cases was traced to food establishments and places receiving visits of rats and mice. Through the studies of Dyer, Rumreich and Badger (1931) and others it is now proven that the rat is a reservoir for the infection in man. Bloodsucking arthropods were suspected as

the transmitting agents. To be sure it was demonstrated that the causative organism of typhus fever very closely related to that of Rocky Mountain spotted fever is capable of maintaining itself in the guts of bedbugs and fleas. Dore and Shelmire have shown that the tropical rat mites which feed on the brown rat may convey endemic typhus to man. To date this mite is known to occur at different points along the Atlantic and Gulf coasts, particularly Texas. It is not an easy matter to find these vectors and consequently a wider distribution with all its consequences belongs in the realm of possibilities. Furthermore, the interrelationship of Rocky Mountain spotted fever to endemic typhus has attracted considerable attention since the former has apparently been recognized in Virginia.

Trichinosis has been unduly prevalent in California since 1929. In the course of a study to determine the sources of the heavy infestation of hogs with this round worm, two instances were recorded in which the trichinous meat of bears shot on the open range in Trinity County has caused a severe and fatal human disease. These unique observations emphasize anew the importance of trichinosis as a serious disease which continues to offer many involved problems.

As an endemic disease of dogs rabies assumes from time to time epidemic proportions. If by chance the coyotes become infected a very embarrassing situation both to the inhabitants and to their live stock may develop. Several years ago rabid coyotes endangered the life of school children in Shasta County and caused great losses among bands of sheep. A vigorous campaign finally eradicated the infection, but there is no assurance that in the course of a spread of canine rabies a similar catastrophe may not repeat itself. It is generally recognized that skunks may propagate rabies among their own kind. In fact skunks have been known to attack persons also. The relative inopportunity or lack of the tendency to bite when rabid is probably the only reason human rabies due to skunks is very rare.

Many more examples or a more detailed account of the diseases already mentioned could be given, but these were merely chosen to illustrate the ever increasing complexity of the factors which endanger the health and welfare of the inhabitants in this State and elsewhere. Medical visitors are quite generally impressed by the many new problems which are sometimes thrust upon the public health worker in a western State. There is no need for anxiety as long as everybody continues to contribute his share to the investigations and the control of the maladies.

A SURVEY OF THE DESTRUCTIVENESS OF SARDINE NETS USED IN THE MONTEREY REGION¹

By J. B. PHILLIPS, California State Fisheries Laboratory

TWO CLASSES of circle nets have been responsible for the building up of the California sardine industry—the lampara and the purse nets. There is only the one type of lampara net, called the Italian round haul; of the purse nets there are two types, called the purse seine and the very recent ring net. The lampara net, having no purse rings, must depend upon the speed with which the wings can be pulled in and the fish safely impounded in the deep central bag. The impounding of fish with the purse net depends upon the quick closing of the bottom of the net by means of the purse rings. The lampara net can only be successfully used on a lampara type boat, while the purse seine can only be successfully used on a purse seine type boat. The ring net can be adapted for use on either type of boat.

As the lampara net has not been a factor in the commercial sardine fishery in the Monterey region for the past two seasons and inasmuch as the operations of the lampara net were presented at an earlier date,² the present survey is confined more or less to the two types of purse nets and accompanying gear.

CONTROVERSY NOT A NEW ONE

A historical review of the sardine fishery at Monterey reveals that the competition between the lampara net and the purse seine is not new. With the start of sardine canning in 1903, purse seines were used until 1906.³ In 1905 the lampara net was introduced on the Pacific coast at Monterey, displacing the purse seine, one or two of which continued in use until about 1915. No purse seines were then in operation until 1926. From 1926 until 1929 two purse seine boats using purse seines competed against an overwhelming number of lampara gear. The 1929-1930 season brought an influx of a large number of purse seine boats. In the face of this competition the lampara crews by the end of 1929 discarded the lampara net in favor of the fast working, effective ring net.

W. L. Scofield reported in 1926⁴ that there were several reasons why the purse seines of the early days failed to yield a steady supply of fish. Among the reasons were—unfamiliarity with the habits and movements of the fish, crude methods of operating gear, and improper gear with which to operate the net.

¹Contribution No. 124 from the California State Fisheries Laboratory, March, 1932.

²Scofield, N. B. The lampara net. Calif. Fish and Game, vol. 10, no. 2, p. 66-70, 1924.

³Gill nets were used for the taking of sardines for bait.

⁴Scofield, W. L. Purse seines for California sardines. Calif. Fish and Game, vol. 12, no. 1, pp. 16-19, 1926.

It is interesting to note that the recent return of the purse seine boat and improved fishing gear to the sardine fishery of Monterey is meeting with the same opposition that the lampara net met with when it was introduced. Although the lampara fishermen have attempted to stave off the new gear by discarding the lampara net in favor of the ring net, they are still at a disadvantage in regard to cruising radius of boat and its economy of operation.

It is appropriate at this time to quote from N. B. Scofield's article on the lampara net published in 1924.⁵



Fig. 44. A purse seine boat with a lampara launch alongside. The former is one of the larger types of purse seine boats while the lampara launch is about average. The purse seine boat is complete in itself while the lampara launch tows a lighter as represented in Fig. 45. Photo by J. B. Phillips, October, 1930.

Now that the use of the lampara net is firmly established in California and is considered to be a good and legitimate net by nearly all fishermen, it is interesting to go back to the time when these nets were introduced into the sardine fishery at Monterey and to see the bitter opposition which was raised against their use at that time. The introduction of this net has helped probably more than any other contributing factor in the development of California's great sardine industry and it is hard now for fishermen at Monterey to realize that a large number of them bitterly opposed its use ten or twelve years ago. The introduction of any new form of fishing gear which profoundly affects a fishery is usually met with opposition from fishermen who can not successfully compete with their old-style gear, and their opposition is always on the ground that the new gear is unduly destructive and will ruin the fishery.

In 1913 a bill was introduced in our State Legislature which prohibited the use or the possession of a lampara net in Monterey Bay, and this bill had a good chance of passing. It is as much the duty of the Fish and Game Commission to prevent ill-advised legislation whenever possible as it is its duty to advocate restrictive measures wherever any fishery is in danger of exhaustion. Therefore the Commission, desiring more information in regard to the use of this new net, for the bill was to come up before the Assembly Fish and Game Committee within a few days, asked the writer to proceed to Monterey and report on conditions as he found them.

For similar reasons the present investigation of the destructiveness of sardine gear was inaugurated.

⁵ Scofield, N. B., loc. cit., p. 66.

ASSIGNMENT OF PROBLEM

The present writer has been stationed at Monterey for the past three seasons checking on the commercial catch. Frequent trips on sardine boats are required as part of the duties. In view of recent improvements in fishing gear and the objections raised, an intensive survey was carried on during the past sardine season in regard to the wastage of the nets. The aid of the Division of Fish and Game patrol boat, *Albacore*, was enlisted on some occasions.

Although it may seem in this report that many phases of the sardine fishery are treated in detail, it is felt that an understanding of the many principles involved are necessary for a better understanding of the problem. The results of the survey are summarized at the end of the article.

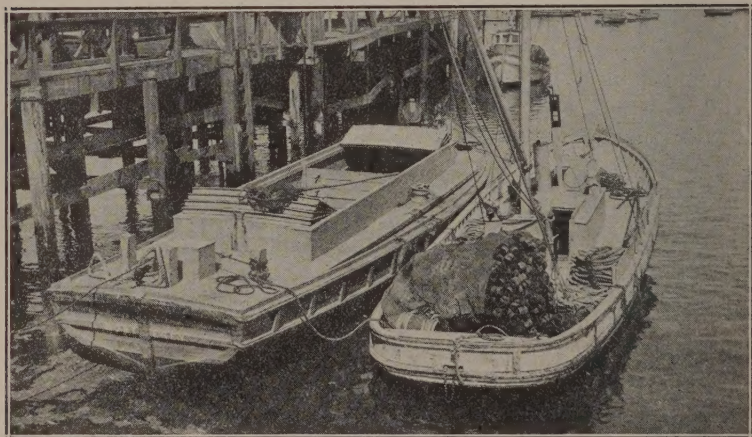


Fig. 45. A lampara lighter with the launch alongside. The lighter carries the catch and is towed to and from the fishing grounds. These two boats are about 45 feet long and the lighter will hold about 50 tons of sardines. Photo by J. B. Phillips, September, 1930.

NETTING OPERATIONS WITH A PURSE NET

Before going into the question of any wastefulness of the nets, it may be an aid in analyzing the problem to give a brief outline of the netting operations, schooling habits of the sardine and the available fishing time.

Inasmuch as, during the past two seasons, the bulk of the lampara boat ring net crews have changed the landing bag from the middle of the net to one end, the netting operations of the two types of purse nets (purse seines and ring nets) used in the Monterey region are very much alike.

After a purse net has been circled around a school of sardines the net hangs in the water like a curtain. The next step is to purse the bottom of the net. This is done by reeling in both ends of the purse rope which passes through the rings attached along the bottom of the net. In the meantime a waterproof electric light is let down about

15-20 fathoms and flashed intermittently on and off. This procedure frightens the fish up and away from the opening which is in the process of being closed. After the bottom of the net is pursed and the rings are on board, the operating lights may be turned on. With the sardines inclined to "sound," the turning on of the operating lights keeps the fish beneath the surface while the net is being pulled in. With say fifty tons of fish in the net, an uninitiated person would think that there were only a few fish in the net, as the dark green coloration on the backs of the sardines make them very nearly invisible a fathom or two below the surface.

The heaviest webbing of the net is at one end and the catch is bunched into this section of the net called the landing bag. The bunching is accomplished by pulling in the other end of the net thereby herding the catch toward the landing bag. As the fish become more and more bunched, an occasional boiling up of fish will be observed. After enough length of the net has been pulled in so that the fish are well bunched, the catch is concentrated preparatory to unloading the net. This is accomplished by pulling in the webbing to form a relatively shallow bag. To prevent as much as possible the escape of the fish over the cork line at this time, the large skiff is stationed on the opposite side of the net and a section of the cork line pulled into it.

SCHOOLING HABITS OF THE SARDINE

Reference has been made to a Monterey Bay period of scarcity which may be termed a transitional period. In the fall months before this period, the size of the sardines in the population is fairly constant; in the winter months after this period and until the end of the season, the size of the fish increases because the population is made up of older year classes. The fishermen say that the fall population tends to form in shallow schools and the winter population to form in deep schools.⁶ There is not only a seasonal variation in the depth of the schools in one region, but the shape or general outline of the schools may occasionally vary. This is also claimed to be true between regions. For example, the outline of the schools in the Monterey region tends toward compactness, while in the San Pedro region the tendency is toward a long wave-like formation. Obviously where a sardine school is in its most compact form, not so much webbing will be required. Invariably the San Pedro crews have shortened their nets 20-50 fathoms for fishing in the Monterey region.

Although the bulk of the sardines is located by the luminescence the fish create in the water, this is not always the case. Sometimes luminescence is absent or only slightly present due to murky water. In this case sardines are sometimes located by the splashing they cause when feeding at the surface. The luminescence is only visible during the dark of the moon and the degree of visibility depends upon the clearness of the water. When hauls are made during moonlight, at sunset or at daybreak the fish are usually located by their splashing. In such cases the sets are usually blind. Even during the dark of the moon, the sardine schools may remain at the surface for only a short period and then "sound." Then again, the schools may be moving

⁶ This is partly substantiated at Monterey by the writer's observations.

rapidly in various directions. During the latter part of the season just closed, storms interfered a great deal with the scouting and following up of schools.

AVAILABLE FISHING TIME

Sardine fishing is divided into lunar periods, that is, from one full moon to the next. The average lunar period consists of about twenty-nine days. Fishing is carried on almost entirely at night and the bulk of the night fishing is done during the dark of the moon, so that the luminescence will be readily visible. As has been pointed out, due to murky water, hauls are occasionally made during moonlight, at sunset or at daybreak, when fish are jumping.

At full moon time there are usually a few days when fishing activities cease. Within a day or two after full moon time the available fishing time gradually increases nightly until it is dark all night at new moon. The number of idle days at full moon time varies with the season of the year.

SCARCITY OF FISH IN MONTEREY BAY

The complaint that since the ingress of the purse seine boats there has been a scarcity of sardines in Monterey Bay is not sound. In 1930, Lindner⁷ made an analysis of fishing localities for the California sardine from November, 1919, to March, 1929. The results of his analysis showed the following: To meet the increased demand for sardines the fishing area has been expanding to the north each year. A period of scarcity in Monterey Bay sardine fishing appears every year throughout the late fall and winter months. This period has been increasing in duration since the 1921-1922 season. The facts pointed out by Lindner coupled with the placing by Legislature of a restricted season for the first time with the 1929-1930 season were undoubtedly the major factors responsible for the ingress of the purse seine boats and gear during the 1929-1930 season. The purse seine has proven itself by its ability to scout greater distances for fish during periods of scarcity.

COMPLAINTS AGAINST THE PURSE NET AND PURSE SEINE BOAT

It is claimed that there is a relative scarcity of sardines in Monterey Bay and the purse seine gear is blamed for this.

It is claimed that the purse seine gear destroys many tons of sardines by impounding more than can be utilized. When an excess of fish is set free after brailing out the boat limit, the balance of the fish die because of suffocation and loss of scales.

Of course there are other lesser complaints, but these are in the nature of grievances.

⁷ Lindner, Milton J. Fishing localities at Monterey from November, 1919, to March, 1929, for the California sardine (*Sardina caerulea*). Calif. Div. Fish Game, Fish Bull., no. 25, p. 8-27, 1930.

PURSE SEINE MEN DEFEND THEIR GEAR

Summarily, the purse seine men defend their gear as follows: Although there are times that it is hard to judge the amount of fish that is being circled, normally when luminescence is present the amount of fish can be estimated fairly well by the size of the luminescent areas. Schools vary a great deal in size and when a particularly large school is located only a portion of it is circled, enough to fill out the limit. They admit that it is laborious to handle a purse seine and consequently like to make their limit in one set if possible. They claim that the purse seine might be considered advantageous inasmuch as they often pass up many small schools that the lampara crews could take with their fast nets.

The purse seine crews wish that a distinction be made between the purse seine type of boat and the lampara type of boat. They claim that the purse seine type of boat, because of its large cruising radius and accomodation facilities, is able to make extended scouting trips at such times as there is a scarcity of fish in local waters or when the sardines in local waters might contain "green feed," are mixed in size, or are mixed with other varieties of fish. They would also like to have it known that the purse seine boat has the facilities for taking good care of the catch in instances where an over-limit is unavoidably impounded.

WASTEFULNESS OF THE PURSE NET

The wastefulness of the purse seine and ring net is considered in two phases—first, the possibility of avoiding the capturing of an over-limit; and second, the facilities for taking care of an unavoidable over-limit haul.

LAYING OUT AND HAULING NET

It has been claimed that the purse seine and ring net continually capture more fish than they require and that when this surplus is released it is doomed. In this case it is the type of boat and not the type of net that is one of the major factors. In the first place, the voluntary shortening of nets by the San Pedro purse seine crews in the Monterey region indicates that a great excess of fish in the net is undesirable. Toll is taken in damaged nets.⁸ Nevertheless, there is no doubt that the purse type of net has the capacity of impounding more fish than is sometimes needed. This is more apt to be true when low limits are levied by the canneries. However, at such a time any net may have the capacity of taking over the limit. In cases where large luminescent areas indicate the presence of sardines, only a portion need be circled at such times. But when fish are located by their splashing it is hard to estimate the amount present. In the latter cases the set is blind and no approximation of the amount of the fish in the net can be had until the net is being pulled in. After the fish have been well bunched a crew can tell very closely the tonnage in the net by pushing a pole down and considering the surface area.

In instances when the crew is certain while pulling in the net that they have an excess of fish, they may divide the net into two portions before the fish are too well-bunched. The dividing of the net is accom-

⁸ In addition to overloading, nets are often damaged when sharks or sea lions are impounded with the catch.

plished by starting with the lead line and pulling in the meshes of the net until the cork line is reached. The fish in the one portion of the net are allowed to remain in slack water while the other portion is further bunched or concentrated preparatory to unloading the net. If enough fish are obtained from the one portion, the fish in the other portion can be freed unharmed. Because dividing the net involves quite a bit of added labor it is doubtful that this is done very often.

It has been suggested that where the bag is at one end, as in the case of the purse seine and most of the present day ring nets, that the one end of the bag nearest the boat can be let down and the excess of fish allowed to escape. Although this is possible, it is more apt to lead to total escapement. The strong schooling habits of the sardine would undoubtedly exert a great pressure on the opening and even prevent its being closed until the bulk of the fish escapes.

Where several crews are fishing in the same vicinity, as is nearly always the case, one crew if it has a surplus will donate to another less



Fig. 46. A lampara sardine crew unloading at a cannery with a shallow dip net. This same dip net is used in unloading the catch from the net. Photo By J. B. Phillips, September, 1931.

fortunate crew. Crews are attracted to the vicinity where another crew is making a haul or is unloading, as the chances are good that there are other schools nearby. With low limits, sometimes two crews agree to alternate, with one crew going out for two limits.

UNLOADING OF CATCH

It is the degree of concentration of catch preparatory to unloading and the time thus held that are most important in cases of over-limit catches. It is just as necessary for a fish to have oxygen as it is for other animals. However, a fish is so constructed that it can only extract oxygen from water. In their efforts to resist suffocation, when the catch is greatly concentrated, the fish attempt desperately to free themselves. In this manner the sardine may lose scales. The sardine can lose some scales without ill effects, as all loose scaled fishes have power of regenera-

tion of scales. Nevertheless, the loss of a great many scales at one time would no doubt have dire effects through infection.

Observations made of the unloading operations of the lampara type of boat and the purse seine type of boat show the latter type of boat to be in a better position to take care of the impounded catch. The high mast, the long boom and the added power of the purse seine boat permit the use of a dip net having a very long bag for unloading the catch. These dip nets have an iron ring from 4-5 feet in diameter from which is suspended a bag of netting, 18-24 feet long. A long wooden handle, usually the length of the bag, is attached to the ring so that the mouth of dip net can be guided. The net is lowered or hoisted by means of a rope, attached to the ring, which runs up through a block at the end of the boom. The net is lowered or hoisted by means of a rope, attached to the ring, which runs up through a block at the end of the boom. The dip net is emptied by placing the ring perpendicular to the edge of the hold and by hoisting up on the end of the bag.



Fig. 47. A purse seine crew unloading at a cannery with a shallow dip net. This dip net is only used for unloading at the cannery. A portion of the webbing of a long bag dip net, which is used in unloading the catch from the net, can be seen hanging above the right hand edge of the hold. (Also illustrated in figure 48. Photo by J. B. Phillips, August, 1930.

Unloading operations of the lampara type of boat are conducted by means of a shallower dip net. Nearly all of the dip nets used by this type of boat have a ring or mouth from 3-3½ feet in diameter. The bag of webbing attached to the ring is about 4 feet deep. A fairly long handle is attached to the ring so that the net can be guided. The contents are emptied through the bottom of the dip net. This is accomplished by releasing the tension on a chain that runs through small rings along the bottom edge of the webbing. The net is lowered or raised by means of a rope running through a block at the end of a short boom. Previous to the wholesale adoption of ring nets by the lampara crews, the catch used to be unloaded by the use of 3 or 4 small hand dip nets with 3 men to a dip net. The unloading time was slow—probably with 4 of the

man-powered dip nets working at top speed, as much may have been accomplished as one of the present day shallow dip nets.

Obviously, in the case of the shallow dip net, the catch must always be concentrated to a great degree in order to unload the net efficiently. In the case of the long bag dip net the amount of concentration varies with the different boats. Sometimes, as with a weak purse net,



Fig. 48. A long bag dip net which is part of the equipment of sardine purse seine boats. The long handle, attached to the iron ring, is here shown slashed to the ladder. This dip net has a 4-foot mouth and a 20-foot bag. Photo by J. B. Phillips, February, 1932.

the fish are hardly more than bunched. Sometimes the degree of concentration approaches that of the small boats. In any case, when the catch is concentrated to such a degree that in their struggles the fish continually break water and produce an audible hissing noise, any surplus that is freed would undoubtedly be doomed if held very long.

In timing the unloading operations of the boats using the long bag dip net and the shallow dip net, the following was found: The boats using the long bag dip net can normally unload 60-80 tons per hour at 1500-3500 pounds per dip from their nets, while with the shallow dip net, 25-35 tons an hour at 400-600 pounds per dip is the normal rate of unloading. Under very favorable conditions, the long bag dip net can unload 100 tons per hour, as against 40 tons per hour for the shallow dip net. There is more of a time variation with the long bag dip net because of the variation in size of nets and the degree of concentration of catch. The shallow dip nets are fairly well standardized as to size, and concentration of catch must be fairly great for effectiveness.

When Bonnot⁹ made his survey during the 1928-1929 season, the two purse seine boats then at Monterey were still using a shallow dip net. With the start of the 1929-1930 season and the ingress of purse seine boats, the long bag or stocking dip net was introduced. This type of dip net is now part of the equipment of all the purse seine boats, as well as shallow dip nets which are used for unloading the fish from the boat at the cannery. The lampara boats use the same shallow dip net for unloading the catch from the net and for unloading the catch from their lighters at the cannery.

Lampara and purse net crews alike admit that dead or weakened sardines tend to "sound," that is, head downwards. Fish in such a condition are practically dead weight in contrast to the herding quality of live and active fish. It is harder work, with more danger of tearing a net, to haul in just a few tons of dead or weakened sardines than to haul in many tons of live and active sardines. Probably the best argument for the use of the long bag dip net is that the mouth of it can be pushed down far enough to scoop up the dead or weakened fish from the bottom of the net.

FISH AND GAME ORDER NO. 12

During previous seasons there have been many tons of sardines wasted in the course of a season because of the dumping of over-limit catches after the crews had unloaded at the canneries. Even though limits might have been pronounced by the canneries, crews sometimes might have brought in over-limit catches in the anticipation that other crews had missed or had torn their nets. Before the start of the 1931-1932 season the Division of Fish and Game issued Order No. 12, consisting of two regulations. Regulation 1 prohibited the dumping of fish and required a bona fide order for the amount of fish delivered to the plant. Regulation 2 required that not more fish be impounded in the net than the crew actually had an order for, and that any surplus of fish be released in a healthy condition before brailing operations commenced.

One would gather from hearing the one side of the controversy that the purse seine boats captured a great deal more fish than they actually needed every time they set out. During the 1931-1932 season, just closed, either Order No. 12 had the desired effect or the over-catching properties of the purse seine have been over-rated. In going through

⁹ Bonnot, Paul. Report on the relative merits and demerits of purse seines vs. lampara nets in the taking of sardines. Calif. Fish and Game, vol. 16, no. 2, p. 125-130, 1930.

the regular season sample records, purse seine boats are represented as making 129 catches. Forty-eight of the catches, or 37 per cent, fell at least 5 tons under the limit; 44 catches, or 34 per cent, at least 10 tons under the limit; 37 catches, or 29 per cent, at least 20 tons under the limit. There are no records of the boats that missed entirely. In cases where no limit was levied by the cannery, just the hold capacity of that particular boat was taken as the limit. It is evident that in 35-40 per cent of the cases throughout the season, the purse seine boats made hauls that resulted in 5-10 tons under the limit loads. When fish are loaded into the hold of a boat, the tonnage can be told quite accurately. If the fish are available, in cases of limits, the load is apt to be a ton or so over the limit, or in cases of no limits, the hold may be filled with possibly a deck-load in addition.

SUMMARY AND RECOMMENDATIONS

Any efficient fishing gear has capabilities of catching more fish than the fishermen can dispose of, especially at such times that limits are in effect. In the case of sardine nets, it is not the gear that is responsible but the handlers of the gear. However, no type of fishing gear should be encouraged unless it is shown that the gear, properly handled, does not continually destroy a large surplus of fish.

A survey of the netting operations of purse seines and ring nets in the sardine fishery in the Monterey region may be summarized as follows:

1. A period of scarcity of sardines in Monterey Bay was present and growing in length of duration at a time when the purse net was not in use at Monterey.

2. The voluntary shortening of purse seines by southern California sardine crews fishing in the Monterey region tends to show that an excess of fish in the net is undesirable. When luminescence is absent, the haul is more or less blind, and an excess is impounded, a purse seine can be divided or the surplus allowed to escape over the cork line.

3. In the case of the purse seine boats, the use of the long bag dip net reduces materially the time that fish are held in a bunched state and allows the weakened or dead fish to be scooped first from the bottom of the net. For the proper manipulation of this dip net, the catch should not be bunched too tightly.

4. That purse seine boats are not continually making over-limit catches is shown in an analysis of sample records. Based on the 1931-1932 season records, hauls made by the purse seine fleet resulted in under-limit catches in 35-40 per cent of the cases. No record is available of the times that the boats missed entirely.

5. Continued enforcement of Order No. 12, issued by the Division of Fish and Game prior to the 1931-1932 season, is all that is recommended at this time.

RELATIVE DESTRUCTIVENESS OF SARDINE CIRCLE NETS IN SOUTHERN CALIFORNIA¹

By G. H. CLARK, California State Fisheries Laboratory

THE QUESTION has come up recently as to the relative destructiveness to sardines of the three types of circle nets used in southern California waters: the lampara, the ring net, and the purse seine. The purpose of this report is to summarize the observations made by the members of the California State Fisheries Laboratory staff and their researches into the subject of the operation and use of these various nets. It has been concluded from the evidence here presented that if the fishermen operating any one of the three nets use a fair amount of judgment that none of these nets will destroy any appreciable amount of fish life other than that which is taken for food to the markets and canneries.

OPERATION OF NETS

The three types of circles nets used in fishing sardines in southern California are operated in about the same manner. That is, they are laid out in a circle around a school of fish; then the net is manipulated so that the fish are captured and held in a bag. The fish are then further concentrated in a smaller space and dipped into the boat by means of a large dip net. The construction of these nets is different so that the method of impounding the fish is not the same for each type of gear. As far as the sighting of schools of fish, estimating the number of tons in them, and the actual setting of the net are concerned, the crews using any one of the three types of net follow similar methods. Experienced fishermen are remarkable in their ability to estimate the tonnage of a school of fish. If the school, according to their best estimate, contains the desired amount of fish, they will circle the entire school (depending on the type and size of their fishing gear), but if the school is too large they may "split" the mass and circle half or a third of it. "Splitting" can be done if the fish are not too "wild" or active.

After circling, the fish are impounded, in the case of the lampara, by hauling in the wings and lead line in order to confine the fish in the "bunt" or bag; with the ring net, by simultaneously pursing the net and pulling in the wings, and with the purse seine by completely pursing the net and then hauling aboard the rings and the lead line, together with part of the net.

After the fish are impounded, the captain may decide that there is a surplus, in which case the cork line (on that portion of the net farthest from the boat) is submerged until a sufficient number of fish escape. The cork line is then allowed to come to the surface and the remainder of the captured fish is confined prior to being dipped into the boat.

¹ Contribution No. 122 from the California State Fisheries Laboratory, January, 1932.

In the event that the sardines are "wild" and it is impossible to estimate accurately the tonnage in a school, the fishermen using a purse seine may set the net and impound the whole mass. Then, in order not to destroy the fish or to confine all of them too closely, the impounded fish are divided into two groups by pulling along a row of knots in the net. One group is then confined more closely and dipped into the boat. In case the first group does not contain the required amount, some fish may be taken out of the other section. However, if the first group fills the need, the second group is liberated by sinking the cork line, in which case no fish are destroyed.

DIPPING OR BRAILING

Dipping or brailing the sardines from the water to the boat is done in the same way regardless of the type of net used to capture the fish. A large dip net with a long handle is operated usually from the skiff, which is stationed on the opposite side of the net from the boat. The net is dipped down into the water where the fish are confined, pushed by means of the handle, and dragged along by the rope attached to it from the boom. Then the net is lifted clear by the boom rope with the aid of a power winch. The dip net is pushed to a position over the hatch, and the purse line which closes the bottom of the net is released to allow the sardines to drop into the hold. If a small (shallow) dip net is used, from 500 to 700 pounds of sardines can be transported to the hold of the boat at each dip. Using this type of dip net, the fish can be removed from the impounded area at an average of one ton every three minutes, or about 2 hours for a 40-ton catch. However, if the larger dip net is used (this type was employed almost exclusively for sardines in southern California during the 1931-1932 season) the fish can be unloaded from the net at the rate of about a ton a minute or even faster, so that a 40-ton catch can be unloaded in about 30 to 40 minutes. These large dip nets are from 20 to 25 feet long and scoop up from 1500 to 2500 pounds at a time. Such dip nets are operated from the boat; they have no opening in the bottom but are inverted into the hold. Some of the sardines near the bottom of the confined area in the water are bound to be smothered, but this is only a very small percentage. Such fish are still good and of course are loaded on the boat with the rest of the catch. No large numbers of fish are impounded in the net above the amount wanted by the fishermen. As stated before, experienced fishermen seldom catch much above the required limit; perhaps there may be a difference of one or two tons above or below the set amount, but this is not enough to be of any consequence. In our opinion, very few sardines are destroyed in the operations of the three types of circle nets if the fishermen use reasonably good judgment.

BOAT LOADS

After the sardines are loaded on the boat, the net is piled aboard and the boat goes back to port to deliver the catch. If the fish are delivered the same day (24-hour period) as caught, they are almost always in a good condition. Very few fish are crushed during the dipping process from net to boat or from being stored in the hold. It

has been noticed repeatedly that mackerel caught relatively close to port by a circle net are still alive when delivered to the cannery; that is, the ones on top of the boat-load, and these are the fish which are brailled last from the net, which indicates that the weight of the other fish does not smother or crush the ones on the bottom. In some cases, the mackerel have been known to be so lively after delivery that they "flopped" off the cutting tables in the cannery. "Soft" fish are thrown away, not because of being crushed in the net but because they were stored in the hold for two days or more or were transported a long distance, causing the fish to become soft and unfit for canning. This condition usually occurs when inclement weather hinders the boats from returning to port immediately after the catches are made.

DIFFERENCES IN OPERATING NETS

The lampara net is no longer a factor in sardine cannery fishing in southern California. Some of the smaller market boats use lamparas for various other species of fish but no great amount is taken by this gear. Lamparas are employed a great deal in catching live bait (mostly small sardines), the same method being used as in fishing for other sizes of sardines, except that the fish caught for bait are placed in tanks to be used later as live bait. Naturally, these fish are not destroyed because it is to the fisherman's advantage to keep them alive. However, the operation of the lampara net is the same as when fishing for market species.

Ring nets and purse seines, and not lamparas, are used for commercial fishing for sardines and mackerel. (The operating methods have been described above.)

The main difference in the use of the ring net and the purse seine is the fact that the ring net is easier to handle. A crew employing a ring net can circle a small school of fish, whereas, in the case of a purse seine crew a small school would not be considered because of the greater amount of labor involved in operating a purse seine. It is perhaps true that the purse seine is capable of impounding and holding a larger amount of fish than either the ring net or the lampara, although if proper care and judgment are exercised, purse seines need be no more destructive of fish than the lampara or ring net. The whole question of destructiveness of fish in circle nets rests with the individual who directs the fishing operations. Even though a ring net or lampara impounds a smaller number of fish each set, such gear must make more sets in order to equal the tonnage secured by a purse seine boat. For instance, if the cannery limit is 40 tons, a purse seine crew may impound 50 tons in the net and release 10 tons; a ring net or lampara crew may make 2 sets, the first impounding 20 tons and the next attempt 10 tons, in which case they would have to be content with 30 tons or make an additional set that may result in 20 more tons. The ring net or lampara crew then would have to release the surplus of 10 tons, as in the case of the purse seine, and keep the rest, or they can dip out half the fish in the net and then dump the remainder out of the net, although the fish may have been damaged. It is not the net which destroys fish but destruction is due to the lack of good judgment and care on the

part of the individual fishermen, regardless of the type of gear used. Criticism of the purse seine has been based on the fact that it can impound large amounts of fish. Suppose a purse seine does capture 200 tons but can use only 40 tons—the crew does not keep the 200 tons in confinement until 40 tons are dipped into the boat, as this great weight of 200 tons might tear the net if retained very long. A ring net or lampara is subject to this same danger if too large a school is impounded.

SUMMARY

All circle nets (lampara, ring and purse seine) are operated similarly. Catches made by such gear are brailed in the same manner. These nets can be operated in such a way that excess impounded fish can be released from the net without being damaged. The purse seine is capable of impounding a larger amount of fish than the ring net or lampara at one time, but the ring net and lampara have to be set more often in order to obtain the same tonnage as the purse seine.

If fishermen are careful, no appreciable amount of fish need be destroyed by any of the three types of circle nets.

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PARASITISM OF THE CALIFORNIA VALLEY QUAIL BY *HAEMOPROTEUS LOPHORTYX*, A PROTOZOAN BLOOD PARASITE

By E. C. O'ROKE

(With five figures and two plates by the author)

THE CALIFORNIA VALLEY QUAIL, *Lophortyx californica* Shaw, has long been identified in the minds of sportsmen as the State's most prized game bird. In the minds of bird students and naturalists, it is similarly a favorite. Changing conditions associated with the development of the country have brought about changes in distribution and relative numbers of quail, in some cases beneficial to the welfare of the birds and in others just the reverse.

One of the activities of the Division of Fish and Game concerning quail has been a series of studies into the possibilities of parasitism and disease as being factors of importance in influencing the present distribution and numbers of the birds.

In the following pages will be found a comprehensive account of observational and experimental work with a blood parasite of the valley quail which was discovered near Yountville, California, in 1927. The quail on which the original discovery was made was shot near the state game farm, and the thought that immediately suggested itself was that possibly the parasite had been brought into the state through introduced game birds that were being propagated at the game farm.

In order to test this hypothesis, several species of penned birds at the game farm as well as wild birds taken near the pens were examined, but none of them revealed the presence of the parasite that had been found in the quail.

The survey was then extended to areas far removed from the game farm and several additional records obtained of the presence of the parasite in quail. From these records it was apparent that the parasite has no relationship to introduced game birds. In the meantime, evidence was accumulating that the parasite was of considerable economic importance and might be the cause of serious sickness and even deaths among quail.

From available literature, it was evident that the organism under observation was protozoan, belonging to either the genus *Haemoproteus* or *Proteosoma*, sporozoans which are capable of producing disease in birds known as bird malaria. The important biological difference between the two genera is that *Proteosoma* can be transmitted by direct blood inoculation, whereas *Haemoproteus* can not be. The first experimental work that was done, therefore, was a series of blood inoculation experiments. Blood from parasitized quail was inoculated into susceptible young quail as well as into young pheasants and chicks. All such attempts at transmission were futile fixing the identity of the parasite as *Haemoproteus*.

A complete check of the literature on the *Haemoproteidae* of birds indicated that this particular species was new to science. It has therefore been described as such under the name of *Haemoproteus lophortyx*.¹

As soon as the investigations were well under way, the work resolved itself into a series of studies along the following lines:

1. Host and geographic distribution of the parasite.
2. Collecting ectoparasitic louse flies of quail.
3. Experimental transmission of the parasite.
4. Life history of the parasite.
5. Pathology, disease symptoms in infected birds.
6. Some problems of infection and immunity.
7. The possible influence of certain ecological factors.

The various studies were carried on concurrently, each week's observations usually contributing towards progress along several of the above lines. For clearness in presenting the results of the above studies, they will be grouped under the headings outlined above.

HOST AND GEOGRAPHIC DISTRIBUTION

The records of parasitism of birds by various species of *Haemoproteus* are largely from the old world, although Opie (1898)² gives a list of several North American birds taken largely in the vicinity of Baltimore, Maryland, which were parasitized with blood parasites of the genus *Haemoproteus*. He did not include any quail, partridges or other gallinaceous birds in the list and did not assign specific or varietal names to any of the different kinds of *Haemoproteus* which he found.

A typical example of one of the more comprehensive European lists of host birds is that of Galli-Valerio (1902).³ He examined 101 birds belonging to 29 genera and 36 species in the Alpine regions of central Europe. Among them he found *Haemoproteus* in 16 genera and 18 species. In the present studies, an attempt was made to examine as many species as possible which were to be found in the same environment as the valley quail. Twenty-eight genera and 36 species in all were examined. Ten of these species, however, were wild ducks and geese and should really not be included in the list for comparison. In all, a total of 170 individual birds were examined. Of this entire lot of birds other than quail, only one species, *Aphelocoma californica*, yielded any *Haemoproteus*. Three individuals, only, were parasitized. They were all from one lot and were shot near Orinda, California, September 30, 1928. Parasitism in these blue jays was very light and the species of *Haemoproteus* was not determined. Fourteen other blue jays taken at various places and at various times were not parasitized. Whether the parasites in the blue jays may have been *Haemoproteus lophortyx* is not known because of the inability of the writer to identify them from the scanty material.

Contrasted with these negative records previously enumerated is the widespread distribution of *Haemoproteus lophortyx* in quail of the genus *Lophortyx* taken in California. Collecting extended over the period of time from December, 1927, to July, 1929. Wherever possible, the blood sample was taken from the wing vein of the living quail in order to avoid needless sacrifice of the birds.

¹ O'Roke, Earl C. The morphology of *Haemoproteus lophortyx* sp. nov. Science, Vol. 70, No. 1818, p. 432.

² Opie, E. L. On the Haemocytosia of birds. Journ. Exp. Med., 3, 79-101, pl. 9.

³ Galli-Valerio, B. Untersuchungen über die Hämosporeidien der Alpenvögel. Centralbl. Bakt., 1, Abt., 31, 162-165.

EXPLANATION OF PLATES

PLATE 1

Fig. 1. Salivary glands of *Lynchia hirsuta*. Iron-haematoxylin stain, photomicrograph, $\times 280$.

Fig. 2. Sporozoites in salivary glands of *Lynchia hirsuta*. Iron-haematoxylin stain, photomicrograph, $\times 80$.

Fig. 3. Oöcysts on wall of mid-gut of *Lynchia hirsuta*. Sketch from living material. $\times$ about 350.

Fig. 4. Section of spleen of infected quail showing pigment deposits. Unstained, cleared material, photomicrograph, $\times 200$.

Fig. 5. Section of testis of infected quail showing pigment deposits. Iron-haematoxylin stain, photomicrograph, $\times 200$.

Fig. 6. Smear preparation of lung of infected quail showing pigment deposits. Unstained, cleared material, photomicrograph, $\times 80$.

Fig. 7. Sausage-shaped schizont from spleen of infected quail. Iron-haematoxylin stain. $\times 1266$.

Fig. 8. Male gametocyte, just preceding liberation of male gametes. Dark field illumination. $\times$ about 2500.

Fig. 9. Living microgamete. Dark field illumination. $\times$ about 5000.

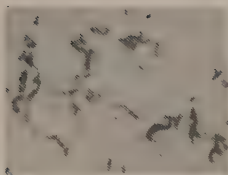
Fig. 10. Merozoites in epithelial cell from liver. Giemsa's stain. $\times 1866$.

Fig. 11. Sporozoites of *Haemoproteus lophortyx*. Iron-haematoxylin stain. $\times 3500$.

Fig. 12. Sporozoites of *H. columbae*. Redrawn after Adie (1921). $\times 3500$.



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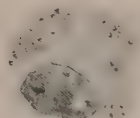
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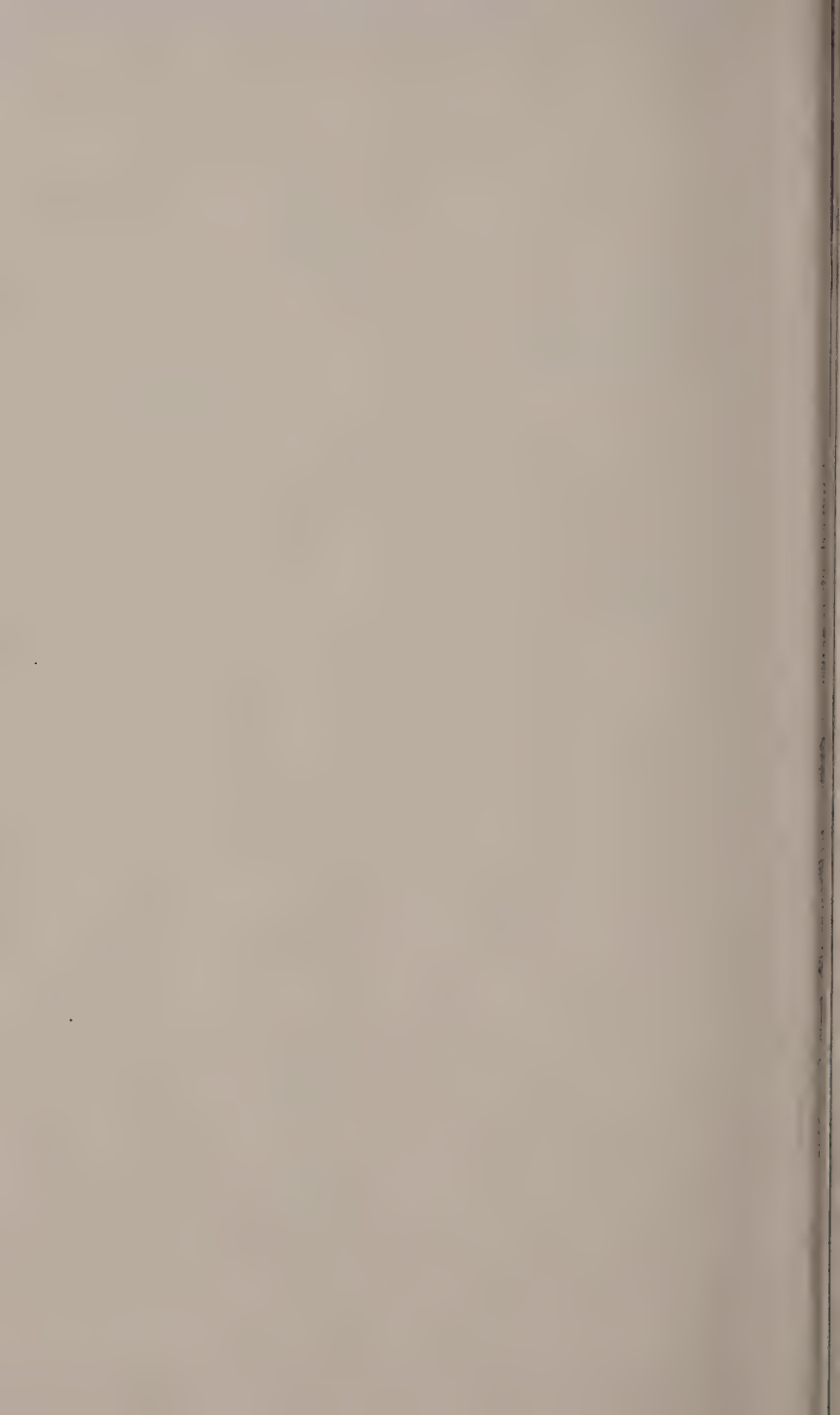


PLATE 2

All figures drawn with camera lucida. $\times 2533$. Methyl alcohol fixation, Giemsa's stain.

Figs. 13-16. Developing gametocytes.

Fig. 17. Mature male gametocyte in blood cell.

Fig. 18. Mature male gametocyte out of blood cell and rounded up preparatory to gametogenesis.

Figs. 19-23. Successive divisions of the nucleus of the gametocyte resulting in the formation of the nuclei of the microgametes.

Fig. 24. Male gametes in various stages of development. One mature male gamete visible.

Fig. 25. Residual mass of male gametocyte after the liberation of the microgametes.

Fig. 26. Free microgametes.

Fig. 27. Female gametocyte in blood cell.

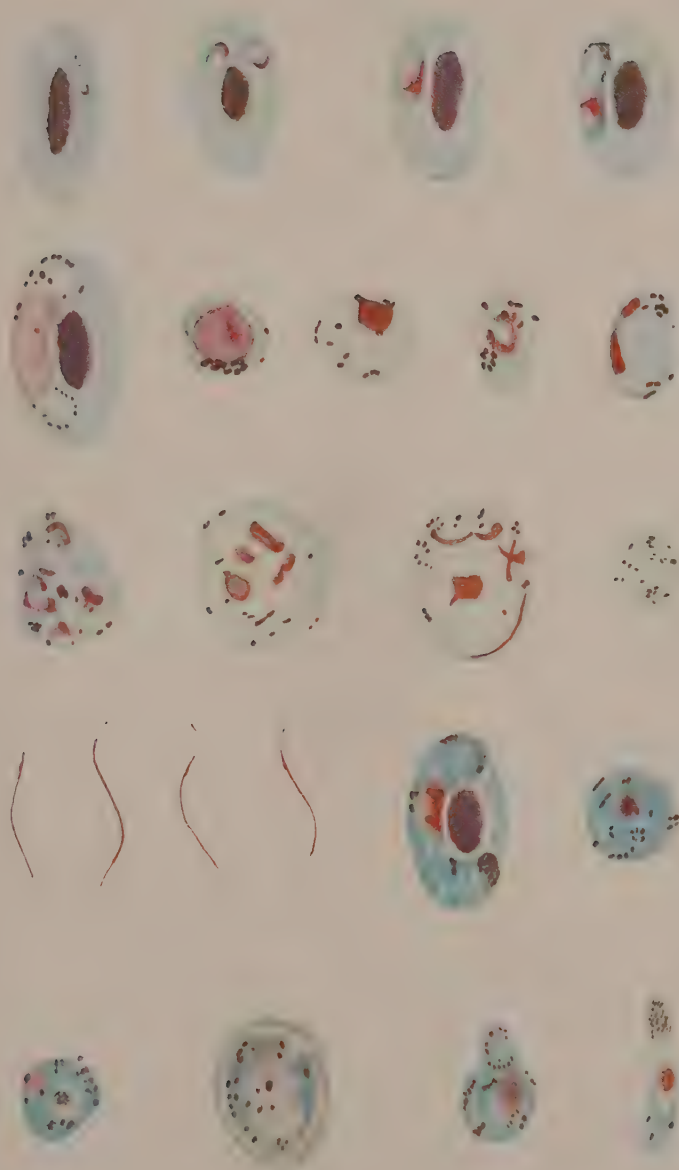
Fig. 28. Female gametocyte outside of blood cell and rounded up preparatory to gametogenesis.

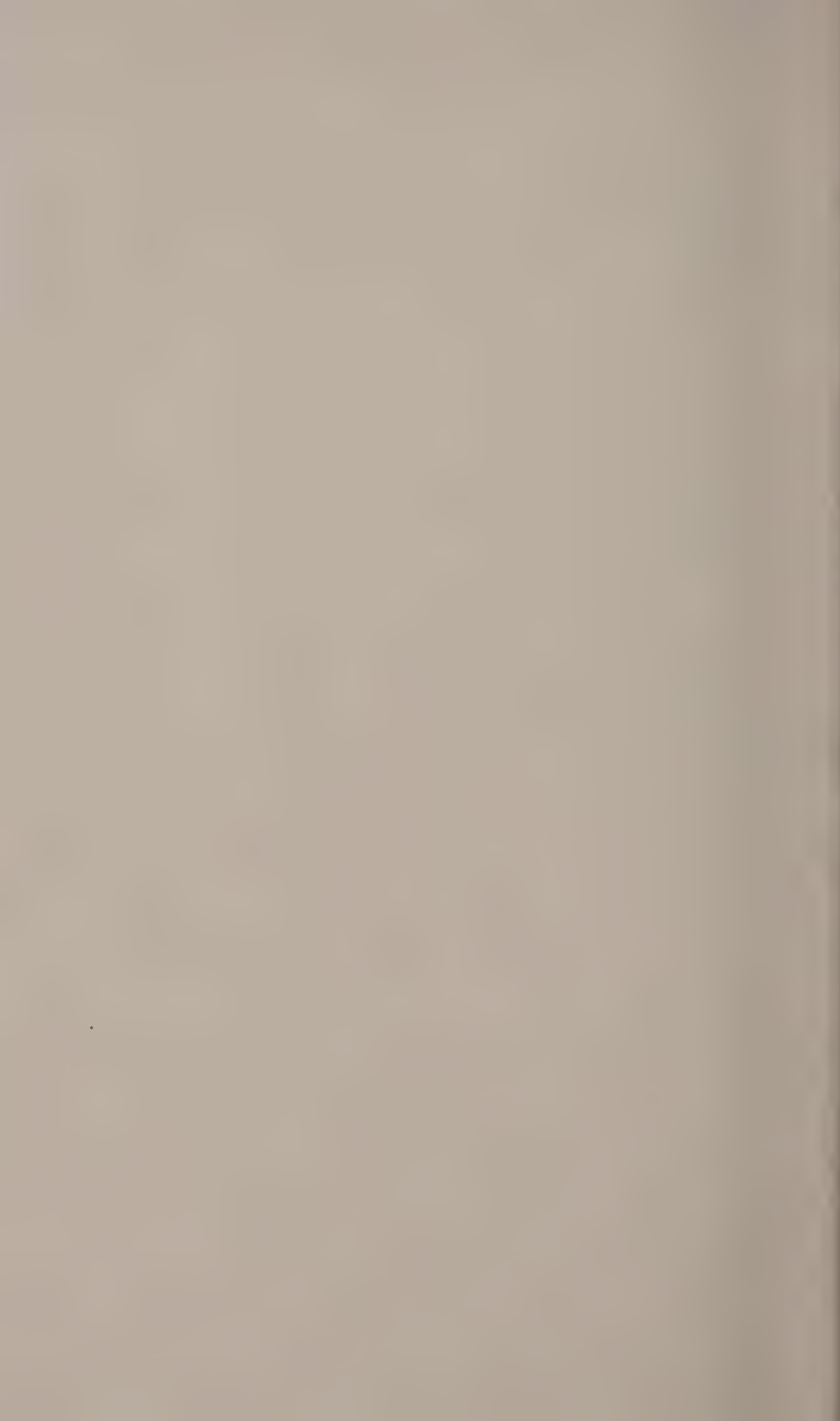
Fig. 29. Macrogamete and polar cell.

Fig. 30. Zygote with fertilization membrane. Thickness of membrane exaggerated.

Fig. 31. Elongating oökinete.

Fig. 32. Motile oökinete.





The source of supply was the State game farm at Yountville, numerous private aviaries, birds trapped and sent in by deputies or shot by the writer. For the purpose of the investigations, it was necessary to shoot several quail during the closed season. The usual practice was to take samples here and there from numerous coveys. When we were operating in settled communities we always made it a point to explain to the ranchmen what we were doing and why we were doing it and



FIG. 49.

to ask permission to take the necessary samples for study. Altogether 312 quail were examined. These included all of the species and subspecies of the genus *Lophortyx* which are to be found in California, including Santa Catalina Island. Of all of the quail examined, 45 per cent were parasitized. Parasitism in different lots varies from

0 to 100 per cent. No species or subspecies of the genus *Lophortyx* was found to be free from the parasites. The highest per cent of infection, 100 per cent, was found in Gambel Quail at a private aviary. The accompanying map shows the locations where collections were made.

It will be observed that only a few places did not yield parasitized birds, and it is quite probable that more extensive collections made there would have shown that these localities are not exceptions to the general rule.

COLLECTING ECTOPARASITIC LOUSE FLIES OF QUAIL

Since the Sergeant's work (1907)¹ in northern Africa had proved experimentally that *Haemoproteus columbae* Celli and Sanfelice is transmitted by the bite of the louse fly *Lynchia maura*, it seemed probable that some species of louse fly would be found to be responsible for transmitting this newly discovered parasite of the valley quail in California. Accordingly, a survey was made of entomological collections in California which might include such flies. From this study it was ascertained that two species of such flies had been reported from quail in the state. They were namely, *Lynchia hirsuta* Ferris and *Stilbome-topa impressa* Bigot.

The former species had only recently been described by Ferris (1927)², and was represented by only three specimens in the collections of Professor G. F. Ferris, of Stanford University. The latter was represented by two specimens in the University of California collection. With this information as a starting point, field search was instituted. Guided by the knowledge that the louse fly of the pigeon deposits its pupae about cracks and crevices and around nests in pigeon lofts, examination was made of the quail pens at the State Game Farm in the hopes of finding the flies or their pupae. Repeated examinations made during May and June proved to be fruitless. The next step was to drive the quail into cloth-screened pens at the game farm in the hope of finding the flies on the birds. This likewise yielded negative results. Operations were then extended to the field. Penned quail were taken out into natural environments of the wild quail, left for a few hours and then placed in cloth bags to be examined for any flies that may have alighted on them. Wild quail were trapped and similarly examined, but with entirely negative results. In the meantime, examinations of the roosting places and haunts of wild quail were continued but no hypoboscoid flies were found.

Following upon the failure to obtain flies or their pupae by any of these methods, it became necessary to shoot quail and place them immediately in gauze bags. These bags were made up into conical shape, about a foot long. Field practice indicated that unless a quail could be shot in an open clearing and placed in the gauze bag within a few seconds after it was killed, any flies present among the feathers of the quail would make their escape. After a quail had been placed in a bag, the bottom of the bag was closed with a rubber band. It was

¹ Sergeant, Ed and Et. Etudes sur les hematozoaires d'oiseaux; Ann. Ist. Past., 21, 251-280, pls. 6-7, 5 figs. in text.

² Ferris, G. F. Some American hippoboscidae (diptera pupipera) Canadian Entomologist 59, 246-251, 4 figs. in text.

then held suspended by the apex and any flies that were present invariably crawled up into the tapering part of the cone. It seems to be the instinct of the fly to leave its host immediately after the death of the latter. After the flies had crawled up into the cone, they were transferred to 22mm. shell vials which were carefully inserted into the bag and moved upwards until the flies had been captured. The first



FIG. 50. *Lynchia hirsuta* Ferris. Female, wings removed. After Ferris.
About 25 $\times$.

fly taken by this method was captured on July 7, 1925, at the Whitman Ranch, near Mount Diablo. By November this method had yielded 32 flies. The greatest number taken on any one quail was four. Many had none at all and several only one or two. The only species taken throughout the investigations was *Lynchia hirsuta* Ferris.

Collections of flies were made from several places in the vicinity of Mount Diablo and at a few localities in the Berkeley Hills between Berkeley and Orinda. When a fly was transferred to a vial, it was customary to put the vial in one's shirt pocket in order to keep it alive and warm until such time as it could be used in transmission experiments.



FIG. 51. Screen cage used at Yountville Game Farm in a series of transmission experiments with quail.

During the course of collecting flies, a few facts were gathered which may be of assistance at some time in the future to anyone working out the life history of the fly, which is unknown. No flies were ever found apart from their hosts. A pair of flies were observed in copula October 5. Three different flies were observed to oviposit a pupa immediately after being taken from quail and placed in vials. These ovipositions took place July 7, August 2, and October 5. All of the pupae were placed in a constant temperature box maintained at 35.5 degrees Centigrade. The one obtained August 2 gave rise to a fly in thirty-one days. The other two failed to hatch. The longest time that a fly lived in captivity was five days. They must live considerably longer than this as will be apparent when consideration is given to the development of *Haemoproctus lophortyx* in this fly.

They are, however, delicate and their welfare intimately related to the welfare of their host from which they suck blood for food and from which they obtain warmth. As will be seen in the accompanying figure, their pincher-like feet enable them to hold fast to the feathers of their hosts and their flat bodies enable them to glide under the feathers easily.

EXPERIMENTAL TRANSMISSION OF HAEMOPROTEUS LOPHORTYX

Through the cooperation of August Bade, superintendent of the State Game Farm, at Yountville, 26 young quail were placed with their brooder hens in screened cages immediately after hatching on May 25, 1928. At the beginning of the experiments one cage contained twelve little quail and the other fourteen. The most rigid care was exercised by A. W. Elder and E. D. Platt at the game farm to keep these cages insect free during the time that the quail were being kept for use in the experiments. Some of the quail were removed from time to time and transferred to smaller cages for the fly-biting experiments. The last of the quail were not removed from the screened pens until December 7.

A long series of transmission experiments was planned and carried out. These began by merely placing an infected and uninfected quail from the screen cage in a small laboratory screened cage about 6x12x12 inches together with flies taken from quail shot in the field. Scarcity of flies necessitated improving this procedure and eventually the fly biting method adopted was to place the fly in a small biting cup about 22mm. in diameter and made from bobbinet and gummed paper tape which was sealed into position directly against the skin of the bird.

The usual practice was to confine the fly over night on the body of a quail. When it became apparent that the scarcity of flies might prevent a thorough test by this method of the hypothesis that *Lynchia hirsuta* Ferris was a transmitting host of the parasite, still more accurate experiments were planned. When flies were taken on parasitized quail, they were subjected to microscopic analysis to determine whether the infective stage (sporozoite stage) of the parasite was present in the insect. Three such infected flies were found. One of these taken on October 5, 1928, was heavily infected, its salivary glands being gorged with the sporozoites of *Haemoproteus lophortyx*. The salivary glands of this fly when chopped up in few cubic millimeters of normal saline solution and injected intravenously into the wing vein of a quail produced a positive case of transmission of the parasite, the infection developing in about thirty days. The control quail that were kept in the original screened cages at the game farm remained free from infection with the parasite.

LIFE HISTORY OF THE PARASITE

Haemoproteus lophortyx is a sporozoan having a complicated life cycle similar to that of the causal organisms of human malaria which is transmitted by the bites of mosquitoes. There are two distinct phases in its life cycle, the sexual and the asexual phase. Transmission is biological, the parasite going through the sexual part of its cycle in the body of the fly. A convenient though perhaps not logical starting

point for discussing the life cycle is the gametocyte stage in the red blood cells of the quail. When freshly drawn blood is placed between a slide and a cover slip and examined under the microscope, it will be noticed that the mature male and female gametocytes are at rest in the red blood cells. Within a few minutes after the drop of blood is drawn the male gametocytes escape from the blood cells and round up preparatory to gamete formation. By a process of successive nuclear divisions, the nucleus of the gametocyte forms the nuclei of from four to six male gametes. In addition, to the nucleus, the male gamete is provided with a small amount of cytoplasm. By rupture of the membrane of the gametocyte these gametes are liberated. They are extremely active vermicular organisms.

In the meantime, a single large macrogamete or female gamete is being formed from each female gametocyte through the throwing off of a polar cell. This process is a little slower than that of gamete formation in the male gametocytes. After the gametes are formed, fertilization takes place by the complete entrance of the male gamete into the substance of the female gamete. The process requires but fifteen seconds. As a result of this process a zygote is formed. About twenty minutes later this zygote begins to elongate into a motile oökinete. When this process occurs normally in the stomach of the louse fly *Lynchia hirsuta* Ferris, the oökinete soon burrows through the wall of the stomach and comes to rest on its outer surface, where it develops into an öocyst.

Within the öocyst, repeated nuclear divisions give rise to from 500 to 5000 sporozoites. The mature öocyst then ruptures liberating the minute sporozoites into the haemacoele of the insect. These sporozoites then enter the walls of the salivary glands and come to rest in the central cavities of the tutular glands. When a fly thus infected bites a quail some of these sporozoites are discharged and enter the blood stream of the quail. From here they enter endothelial cells of the blood capillaries of such organs as the lungs, liver and spleen. Through repeated divisions numerous merozoites are produced. These in turn produce more generations of merozoites in the tissues of the organs mentioned above. Finally some of these merozoites give rise to gametocytes which enter red blood cells and grow to maturity. When such mature males and female gametocytes are present in the blood, the bird becomes infective to another bird.

PATHOLOGY, DISEASE SYMPTOMS IN INFECTED BIRDS

Numerous investigators have studied the pathological conditions which are revealed by autopsies performed on infected birds. Few, however, have paid any attention to the appearance and behavior of infected birds and to the possibility that disease produced by *Haemoproteus* may be serious and even fatal. During the progress of this work special attention has been paid to this phase of the studies. As mentioned early in this article over 300 quail have been actually handled. Hundreds of others have been observed in the field. As a result of the observations on living quail, and of autopsies performed on birds used in the investigations, four types or stages of *Haemoproteus* disease may be recognized. These are:

The following diagram illustrates the time element involved in the sexual cycle.

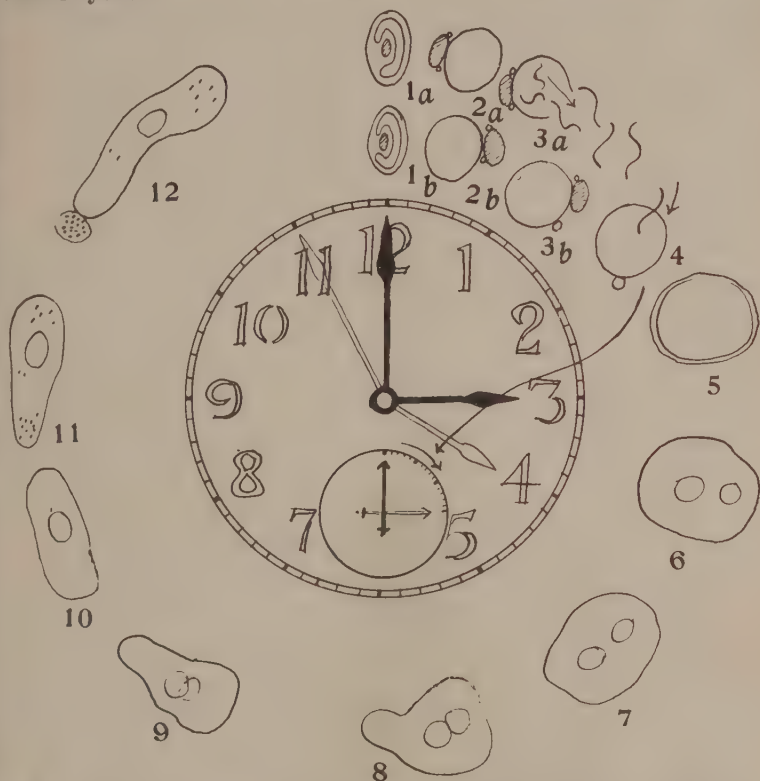


FIG. 52. Diagram showing the time element involved in the events of gametogenesis, fertilization and oökinete formation on the microscope slide at room temperature. 1a, male gametocyte in blood cell; 1b, female gametocyte in blood cell; 2a and 2b, gametocytes out of blood cell and rounded up; 3a, gametogenesis, male gametes formed and liberated; 3b, gametogenesis, female gamete formed; 4, fertilization; 5, fertilization membrane formed; 6-7, resting zygote; 8-10, elongating oökinete; 11-12, motile oökinete.

1. Mild, chronic. This is by far the most common, the quail exhibiting no outward symptoms of disease and the presence of gametocytes in the blood being the only indication that the bird is parasitized. This type of infection is extremely persistent, extending throughout the year. Birds thus infected are undoubtedly carriers although they may manifest no disease symptoms themselves.

2. Mild, acute. This type apparently results from an initial infection the magnitude of which is sufficient to cause the bird some discomfort. It is restless and "off feed" for from two to four days, whereupon the infection is either thrown off or settles down to the chronic type.

3. Moderate, chronic. This type is commonly observed under field conditions. The bird is thin and anemic and more or less weakened. Such an underlying condition might well account for losses of birds in the field due to secondary causes, such as exposure or exhaustion following the nesting season.

4. Heavy, acute. This type occurs in late spring or early summer, whether as the result of new infective fly bites or the lapse of an old infection is not known. The percentage of red blood cells containing gametocytes that have reached the pigment-producing stage may be as high as 10 per cent and even more. The bird loses flesh rapidly, is unable to fly, refuses food, becomes droopy and may die. Only four fatal cases have actually been seen by the writer, and they are believed to be rare. It must be remembered, however, that under natural field conditions, the struggle for existence might eliminate birds before they

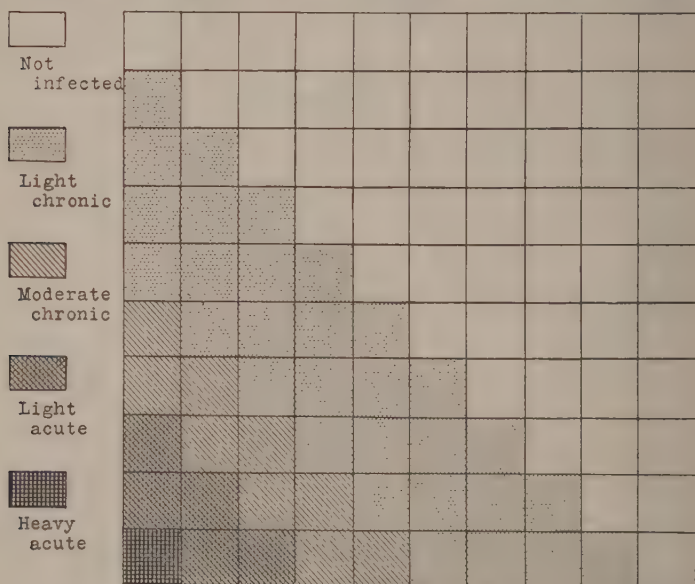


FIG. 53. Graph showing the relative percentages of quail harboring the various classes of infections observed. Chart represents 100 birds, sample population.

reach such a stage of helplessness. Several cases have been reported from widely separated localities of quail that were unable to fly and which could be caught with the hands. Four such cases, personally investigated by the writer, showed the birds to be heavily infected with *Haemoproteus lophortyx*. Two of these cases ended fatally and post-mortem examinations disclosed no lesions other than those due to the *Haemoproteus* infection. No acute fatal cases have ever been observed in young birds less than six weeks old, but it is conceivable that such cases do occur. If, for instance, the brooding birds should be heavily infected and if they should harbor a large number of flies which transmit the parasites, conditions for infecting the young would be ideal.

But anyone familiar with the habits of young quail knows that the chances of finding them where they may have died in their natural surroundings are almost negligible. The fact that young quail raised at game farms and private aviaries are not found to be infected is probably due to the circumstances under which they are hatched and raised apart from their parents, thus not being so readily accessible to any flies which might be living on the adult birds.

As to diagnosis of the disease and post-mortem findings, the presence in the red blood cells of halter-shaped gametocytes which contain black pigment deposits is characteristic. The number of blood cells thus parasitized may run from a fraction of one per cent to more than ten per cent. An almost constant lesion is an enlarged blackened spleen contrasted with the much smaller pink spleen of the normal quail. Similar black pigment deposits may also be found in the lungs and liver. Destruction of the red blood cells by the parasites brings about an anemic condition of the bird. Hypertrophy and loss of elasticity of the blood cells due to the presence of the parasites tends to bring about congestion in the smaller capillaries of the lungs.

In a case of a successful experimental transmission wherein a portion of a lung of an infected quail was transplanted to the body cavity of a susceptible quail, the artificially infected bird was at its lowest ebb just before the developing gametocytes became visible in its blood. This period of depression of the bird was marked by severe anemia, which threatened to end fatally before the bird rallied and recovered. It is conceivable that such a heavy, acute infection could be produced in a natural way by insect transmission and terminate fatally without any gametocytes being discernible in the red blood cells.

From reference to the life cycle of the parasite discussed on previous pages, it is apparent that there is considerable destruction of lung and liver tissue with the multiplication of the merozoite stages of the parasite in the endothelial and epithelial cells of these organs. This, together with any toxic effects that may be produced because of the presence of the parasites, may account for the severity of an initial infection of great intensity.

SOME PROBLEMS OF INFECTION AND IMMUNITY

As previously noted, page 236, infections may vary from extremely light to fatally acute. These variations are probably due to several causes, such as the number of parasitized flies, variations in the virulence of the parasites, and state of natural resistance of the host.

Transmission would seem to be facilitated by the observed fact that gametocytes may be found in the blood of the quail throughout the year, and that flies have been reported from nearly all months of the year. The gregarious habits of quail would also contribute to the ease of transmission. Tending to limit the extent of the infection among quail could be the small number of flies observed, the low percentage of infections among them and the lightness of such infections. It is also possible that the flies are limited to certain portions of the quail range, a subject upon which more data are needed.

POSSIBLE INFLUENCE OF CERTAIN ECOLOGICAL FACTORS

For the most part the experimental work involved in this paper has been done under controlled conditions where the various factors were known and could be evaluated. In a state of nature, it is not always possible to arrive at such precise values. For instance, one hears reports that quail in certain partly protected areas do not increase, and in fact become reduced in numbers. It would be of interest to make most searching investigations into the actual field situation which gives rise to the reports. Does full protection at first result in overcrowding and may such a condition be followed by flare-ups of parasitism and disease which defeat the purpose of protection? What is the situation with regard to parasitism of quail by *Haemoproteus lophortyx* in this respect? We have data showing that in some cases in private aviaries the quail were 100 per cent infected. The highest percentage of infected birds found in any one lot in a state of nature was about 65 per cent. Does the presence of heavily infected, weakened birds react unfavorably upon the rest of the covey? Would such birds under normal conditions be eliminated by predatory animals and certain species of raptorial birds? These are practical questions which can not be answered except by the most painstaking comparative study of field areas over a relatively long period of time.

SUMMARY AND CONCLUSIONS

In the foregoing pages an account has been given of the incidence and pathogenicity of *Haemoproteus lophortyx*, a new species of blood parasite of the California valley quail, Gamble quail and Catalina Island quail. It is widespread in the state, having been found in numerous localities. Fortunately, by far the greater number of cases seem to be light, benign infections, showing that at least partial immunity is well established. Fatal cases do occur, however, and it is possible that *Haemoproteus lophortyx* may be the indirect cause of losses commonly attributed to other causes. The parasite is transmitted from quail to quail by the ectoparasitic louse fly *Lynchia hirsuta* Ferris.

Plates I and II in this paper are identical with those appearing in a more technical account¹ published by the University of California. This publication contains a complete bibliography.

ACKNOWLEDGMENTS

Grateful acknowledgment is made to the many captains and deputies whose assistance in the field was invaluable. Special credit is due to Professor C. A. Kofoed of the University of California under whose supervision the experimental and laboratory work was done.

To Mr. Eugene D. Bennet, Dr. H. C. Bryant, Mr. R. E. Ludlum, Mr. D. D. McLean, Dr. H. Van Roekel, Dr. K. F. Meyer, Professor G. F. Ferris, Professor W. B. Herms and Professor E. C. Van Dyke the writer is indebted for cordial cooperation and assistance.

The painstaking care given the experimental birds at the State Game Farm at Yountville by Superintendent August Bade and his capable assistants as well as many other courtesies extended by Mr. Bade have been greatly appreciated.

¹O'Roke, Earl C. The morphology, transmission and life history of *Haemoproteus lophortyx* O'Roke, a blood parasite of the California valley quail. Univ. of Calif. Pub. in Zool., Vol. 36, No. 1, 1930.

FISHWAYS IN CALIFORNIA

By JOHN SPENCER

IT HAS BEEN SAID that life and living is just a process of adjustment. Conservation workers will have no difficulty in accepting that idea as it is apparent at all times in conservation work and the perpetuation of the wild life is contingent upon intelligent adjustment. Civilization is constantly encroaching upon the realms formerly occupied by fish and game in undisturbed possession and it is too much to expect that we may again have a condition as related by the pioneers, when great herds of deer were seen and "birds in such numbers that their flight obscured the sun," with "migrating fish so thick in the streams that persons walked from shore to shore on their backs." These stories of abundance may be slightly exaggerated but the difference as compared to present conditions may not be denied even by the skeptical. The many established factors which have brought this about are not so generally known. Intelligent conservation work takes cognizance of these factors and makes effort to anticipate changing conditions so that appropriate measures may be affected and thus minimize or postpone the ill effects that otherwise would accrue or possible destruction of the species.

Probably the first adverse factor affecting fish life in this State was the advent of the gold miner in 1849, who very shortly began polluting the streams, making them undesirable to fish life and constructing dams for the diversion of water with no means provided to enable migrating fish to pass these dams to the spawning grounds above. This continued without restriction for many years.

In 1870, twenty years after the State was admitted to the Union, a Board of Fish Commissioners was created charged by law with the restoration and preservation of fish life. The sum of \$5,000 was appropriated to carry on this work. The Commissioners were to be appointed by the Governor and serve at his will and pleasure, without pay. No changes have occurred in this latter provision.

The records of the early work of the Commission furnish most interesting reading. Many problems confronted the early Commissions but probably the most difficult was the indifference of the general public, as few realized or would admit the necessity of attempted changes. Increased responsibilities were given the Commission by the passage of game laws in 1878 and later the legal name became the Fish and Game Commission. Too much credit may not be given those early and conscientious conservationists who pioneered and brought about the passage of the basic fish and game laws.

No doubt the early Commissions though the problems presenting themselves difficult of solution but time has not lessened but rather increased these difficulties. Many more factors enter into the problems and must now be considered if any degree of balance is to be maintained between wild life and the advancing activities of the people.

In 1872 the first fish ladder or fishway law was enacted by the Legislature as it was recognized that the continued construction of

dams by the gold miner would in time destroy the runs of fish up the streams unless suitable means were provided for the passage of fish. Amendments to the law have been made at different times as necessity demanded.

The law now in effect (section 637, Penal Code of State of California) briefly states that the Fish and Game Commission may order installed on any dam or artificial obstruction, a fishway for the passage of fish over or around the dam or obstruction, when in its opinion one is required; such construction being at the expense of the owners. Accompanying the order the Commission must provide a plan of the proposed fishway setting forth location, form and capacity. Legal processes are established for the protection of the owners as well as the State. If there is noncompliance with the order the Commission may carry the matter to the courts for determination. In lieu of fishway installation the Commission may require the construction of a fish hatchery or have fry planted.

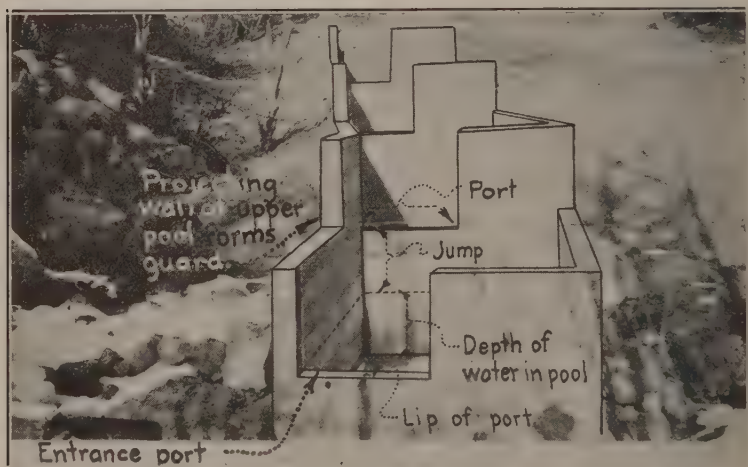


Fig. 54. Portion of concrete fishway without flow of water showing typical construction and nomenclature. Downstream face of dam at left, stream immediately in front of fishway and not shown in photo December, 1928.

In carrying out the obligations imposed on the Commission by the above law a survey of each dam is made and consideration given to the many factors entering into the design of an efficient and adequate fishway. Its location is important. The entrance to the fishway is a major factor in determining the location though the exit into the reservoir together with the general layout receive study. In general it may be said that the entrance should be at a point in or in the immediate vicinity of the line of travel used by the fish and should be as close to the base of the dam as possible and yet avoid the overpour of water over the dam. At some dams freshets or flood waters may cover the lowest pools at times but the entrance to some pool above may be readily found. It appears that the instincts of different species of fish vary, some being very "set" in their ways. Where more than

one species inhabit a stream the entrance to the fishway is practically determined by the less flexible species of fish. Instances do occur, though, where one fishway for a dam is not sufficient. The methods of operation by the owner, intensity and length of flood periods over the dam, accessibility and possibility of channel changes are some of the other items given thought. These points, together with a balancing of the physical conditions, finally determine the location. Every effort is made to produce a plan that will require the minimum of expense and attention by the owner and at the same time be fully adequate for the passage of fish.

While studying the entrance and location of the fishway there has been in the mental background an outline of the "form and capacity" required. The material to be used in construction may not legally be specified in the order though in an endeavor to assist the owner suggestions are made which may be adopted or not, as the owner wishes.

The pool type of fishway, which has been demonstrated to be the most efficient for trout and anadromous fishes, consists of a number of boxes or pools, each higher than the preceding one by a determined amount, the pools joined together and each having a stationary depth of water at least equal to the difference in elevation between the pools (height of jump). At the junction of the pools there is an open section (port) through which the water flows and hence the stationary water height is increased by the depth of the water flowing through the ports. As the fish in their jumping efforts may misjudge direction the sides of the boxes or pools are continued higher by two to four feet. The outside wall adjacent to the port is continued at the same elevation for a distance of about four feet on the next lower pool forming an additional guard and reducing the possibility of fish jumping out of the fishway. The width of the port opening is about one-half the width of the pool and the port lip should not be thicker than six inches unless it is properly beveled. In line with the foregoing for migrating fish of moderate size the minimum size of pools will at least be 6' x 8' by 6' high and at least having $2\frac{1}{2}'$ to 3' of stationary water. For large salmon and/or where the runs may occur in a short space of time an area of 250 square feet is not excessive for each pool.

The difference in elevation between pools (jumps) is determined after considering the varieties of fish that are in the stream or that may be planted, distance and obstacles overcome prior to arrival at fishway—that is, the estimated ability or vitality in negotiating the fishway, water conditions, and the practicability and reasonableness of construction of the fishway. In some fishways it is necessary to interpose between the regular pools larger ones for loafing or resting areas as an aid to the ascending fish.

In the operation of dams changes in water level in the reservoir occur in many instances, these being from seasonal to daily fluctuations. This necessitates a slightly different treatment of the upper pools in order that a regulated flow of water may be passing through the fishway as required.

In a few instances the topography and formation below the dam is such that with very little work the natural ground may be used for the fishway. Where such construction is possible the results are generally very satisfactory.

The photo showing typical construction of fishway has the openings or ports on one side. This is the general practice followed, though changes are made as necessity demands. Construction of some years ago alternated the ports from one side to the other of the fishway. This method created currents contrary to the line of travel by the fish and also lessened the area of quiet water used for resting while preparing for the next jump.

It is apparent that each dam is a problem by itself and before any order and plan for a fishway may be prepared a survey must be made so that the many and varied factors shall be given proper consideration and also comply with the spirit and letter of the law by specifying location, form and capacity of the proposed fishway.

Some streams have one "run" or migration of fish each year while other streams may have two. Where streams have different varieties of fish the "runs" of these varieties may or may not coincide.



Fig. 55. Fishway of concrete construction. Natural rock bank forms bottom and portion of one side. A float at upper port regulates amount of water through fishway.

Some fish are in advance of the main run and others may be termed stragglers, so that there may be some merging of the runs. At times there may be such numbers that there is some concentration or "piling" up of fish at a dam as all can not use the fishway immediately but this occurs only for a limited time. Sometimes the concentration is due to lack of desire to proceed but when the "urge" to move comes the fishway is used and in a short space of time no fish will be visible. When fish are loafing near a dam or in a fishway criticism as to its efficiency generally results as people expect to see a steady procession of fish through the fishway and no false leaps. If the conditions are favorable when anadromous fish enter the mouth of a stream the movement upstream is generally a leisurely one but when the fish are held back by low water and other factors rapid movement may occur when the adverse factors are removed.

While there is a wealth of interesting information about fishes the practical application with the view of conserving and adding to the numbers is not easily determined. There are many other factors besides the need of fishways at dams though these may not be considered in this article. Similar to other things fishway design has been materially changed from the early days and the development has evolved the efficient pool type for the trout and anadromous fishes. This type has been in use for many years. When fishways are carefully designed the construction should be in accord. Departure from plans has necessitated reconstruction of certain fishways which resulted in a loss to the owner and also loss of fish before the work was completed. When operating conditions at a dam change from that obtaining when the fishway was originally designed alterations in the fishway may be required to meet the new conditions.



Fig. 56. Fishway over Folsom dam on American River. Maximum difference in elevation, 45 feet. Lowest four pools (at left) completely submerged. Four adjustable ports at upper section.

There are instances where fishway installation on dams have been delayed or have been inefficient resulting in decreased fish life in that stream. Only by keeping the streams free from obstructions or by the installation of appropriate fishways at dams may fish life be maintained on a normal basis. This is especially true of anadromous fishes. If prevented from ascending to their natural spawning grounds for a few years the run up that stream will be entirely eliminated and only by laborious and expensive planting of fish fry and proper treatment of obstructions and dams can the run again be built up.

In considering designs of fishways the known instincts of the fish should be utilized. They may be induced, but attempts at compulsion result in failure. Mechanical lifting devices have been tried in lieu of fishway construction and also a combination of both. As far as known these can not be classed as entirely successful. An illustration of the latter type of construction may be seen in the Baker River, at Concrete, Washington. A dam about 200 feet high was constructed

there several years ago and equipped with a fishway consisting of pools and a mechanical hoist. Prior to construction Baker River was well known as a salmon stream. The first reports made shortly after construction indicated the successful passing of anadromous fish over this dam. Later reports would indicate that the salmon run up that river is becoming less and if continued Baker River as a salmon stream will cease.

The prosperity of California, in the main, is dependent upon the most efficient utilization of the State's water resources and probably the most ardent conservationists or "dyed in the wool" sportsman would not expect that this development should cease because of possible conflict with fish life. The thought prevails that with orderly and regulated development the benefits of both may be had and enjoyed by the people of the State if due consideration is given the problem and approached on a friendly and cooperative basis. It should be borne in mind that this development creates a problem which heretofore has not been present and the burden of its solution may not honestly be passed entirely to conservation agencies.

The problem becomes more acute as the tendency appears to be toward higher dams and nearer to the floor of the valleys and unless intelligent and well directed experimental work is carried on with the views of successfully passing anadromous fish over these barriers to the spawning grounds beyond the State will lose the valuable commercial and sporting varieties of fish which up to this time have been enjoyed.

BARGE FISHING, A SOUTHERN CALIFORNIA SPORT

By DONALD H. FRY, JR.

IF YOU LIVE within fifty miles of the coast in southern California you are likely to answer your doorbell almost any summer evening to find a neighbor standing on the porch with his hands full of fish. "Can you use any fish?" asks the neighbor. "We went out on a barge today and caught more than we can use." It is only etiquette to accept as many as you can cram in your ice box, particularly if you have been guilty of dumping your own surplus in the same way.

Fishing barges are scattered along the coast from Santa Barbara to San Diego, but are thickest in Santa Monica Bay. They are anchored from a hundred yards to several miles off shore. Some of them are what the term "barge" indicates—low, flat-bottomed, square-ended structures of the type used for hauling gravel. The others are old schooners stripped of practically everything, to make room for as many fishermen as can fit elbow to elbow along the rail. In late years the schooner type has become the more common, probably because it is more seaworthy and can accommodate more people. From the fisherman's point of view the flat barge has one great advantage, as anyone who has tried to lift heavy fish up the high sides of the schooner can testify. It also has one disadvantage—for those who get seasick easily.

The schooners are unbelievably steady. In the course of over twenty trips to them I have never seen a single passenger actively seasick; the trip from shore may make a person groggy, but usually he (or she) feels all right again after a short time on the barge.

The best times of year for barge fishing are the summer and autumn. Fishing in the late spring is sometimes good but can not be relied upon. Winter and early spring are not recommended.

Rates for a day's fishing range from fifty cents to two dollars and a half. The charge covers the use of a long bamboo pole (sometimes prefixed by the word "telegraph") with a hook, sinker, and fifteen feet of line attached to it. Hand-lines and dead or cut bait are also included in the price. Live bait is generally available. It is sometimes free and sometimes costs a cent each to twenty-five cents a dozen, and occasionally comes as high as five cents each.



Fig. 57. A typical fishing barge of the schooner type.

Most live bait is supplied by fishermen who take their catch in the morning with a small round-haul net, and deliver it to floating receivers hung alongside the barge. A second method is to take the bait with a large hoop-net hung over the side of the barge itself. This system produces a scanty supply of inferior quality. At Catalina the bait is taken with hoop-nets, usually baited, but the fishermen go after it instead of waiting for it to come to them. The supply is kept in receivers.

The barges are reached by "speed" boats which take off from a nearby pier. At Redondo there is a barge which has for a landing a motor-driven, floating platform, with a passenger deck elevated several feet above it on stilts. A long gangplank stretches to the shore, the passengers embark, and the whole contraption crawls grumbling through the surf, dragging its gangplank behind it. A speed-boat meets it beyond the breakers and carries the passengers the rest of the way.

When a fisherman arrives at a barge, along with a load of his fellows, the first thing he does is to make a rush for the best looking place and establish himself. Then he gets some bait, a pole (unless he gathered one up in the course of his rush), and starts fishing. If he uses cut bait his first catch will probably be a mackerel. If he strikes

soon enough the mackerel will come sailing through the air and land with a thud on the deck; but if he hesitates and the mackerel gets its head down there will be a fight out of all proportion to the size of the fish. The mackerel must be taken off the hook with an air of disdain. The fact that he is able to outfight many justly famous game fishes must not be allowed to count in his favor. He is just too darned common. To be sure, on barges located in kelp or near rocks, where the mackerel is comparatively scarce, it is sometimes in great demand—as jewfish bait. Mackerel is supposed to be poor eating, but the trouble is that most people do not know how to prepare it. The next time that you have a mackerel, try boiling it fifteen minutes in a saturated salt solution, split it, break away the dark meat, bones and skin, and serve the white meat with a good cream sauce. If more people did this they would probably put their mackerel into their gunny-sacks with more respect.



Fig. 58. Loading live bait into a floating receiver alongside a barge. Note the empty receiver hanging in midair. The searchlight is for night fishing.

If the fisherman uses live bait he may hook a mackerel, bonito, or barracuda. Bonito, the smallest of the tunas, is very like a mackerel on a somewhat larger scale, but is much more highly regarded. A barracuda can generally give a good account of itself during the few seconds allowed it on barge tackle, but if he has a chance to fight he soon proves that he has not the almost unlimited endurance of the bonito or mackerel.

If the fisherman lets a hand-line down to the bottom he is likely to get a halibut, rock cod, sanddab, flounder, or kingfish. The last three are not caught when you are fishing in deep water—they are merely discovered waving feebly on the end of the line. The sanddab and flounder are highly regarded as food; but as the epicurean qualities of

the kingfish are commonly considered on a par with its fighting ability, it is angrily unhooked and thrown back into the water. Its air bladder has been ruptured in the trip up from the depths, so it can not sink but floats helplessly with the current until swallowed by a pelican or torn to pieces by seagulls.

The bow, and to a lesser extent the stern, of a schooner barge is occupied by the fishermen who "fly fish" (*i.e.*, cast with a feather jig) for bonito, always keeping a weather eye out for yellowtail. When a school of yellowtail shows up most of the feather jigs are abandoned



Fig. 59. Swinging a mackerel aboard.

for the largest live bait (up to ten or twelve inches) that the fishermen can lay their hands on. They cast out large live sardines and reel them in slowly, hoping to get a strike, while others are still trying desperately to get suitable bait. Yellowtail bait is not often found in the floating receivers of a barge, so the fishermen catch their own—usually by snagging. When a yellowtail is hooked he must not be allowed to run far. Along the middle of the barge, lines are often only three feet apart,

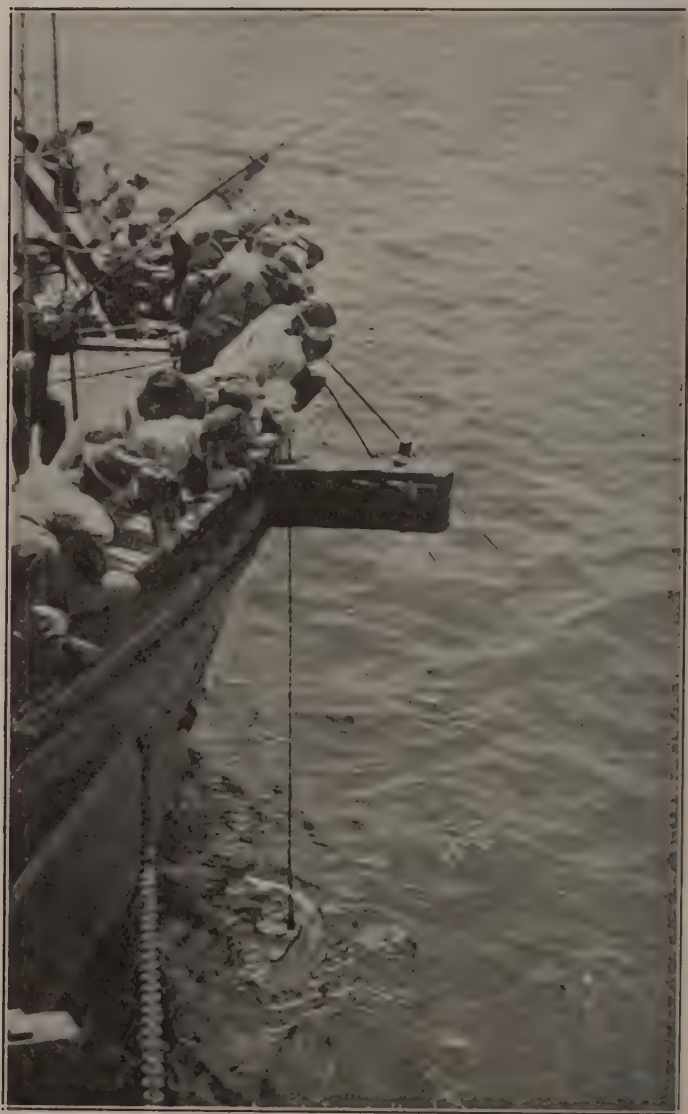


Fig. 60. Gaffing a shark that tried to get away with a jewfish bait.

and if the yellowtail starts doing a maypole dance among them he can create a superlative mess. Light tackle is frowned upon on barges, for if a yellowtail or even a big bonito makes up his mind to go places, he can not be promptly dissuaded with anything much lighter than a surf rod.

There are a few of the men at the bow who fish for the huge, black sea bass or jewfish. They often engage in some other form of fishing while they wait for a bite. The jewfisherman, unlike the man who is after yellowtail, does not use live bait. He sews an entire mackerel to a huge hook and lets it down to the bottom. The jewfish is very deliberate about picking up a bait and when he does take hold of it he must be given plenty of time to get it far enough into his mouth so that a strike will set the hook instead of merely pulling it out. Once he does hook the jewfish, the fisherman is in for plenty of hard work unless the monster cuts the entertainment short by taking a couple of half hitches around the anchor chain or by galloping straight out of the district.

Around the barges located in kelp beds or close to rocks mackerel are less common but there are many additional species not found in the open sea. Rock bass, sheepshead and white sea bass are some of them. These are all good fish, both to catch and to eat. The white sea bass is a special prize.

On the barges, as everywhere else on earth, justice is lamentably lacking. I was once fishing on a barge when a lot of experienced fishermen were offering all the specially caught live bait they could lay their hands on to a yellowtail that showed not the least interest. A raw-boned middle-westerner, obviously on his first barge trip, walked up to the rail with a piece of cut bait on his hook and dropped it in. An instant later he gave a mighty heave and the yellowtail lay flopping on the deck beside him. While everybody looked on, green with envy, he eyed the fish thoughtfully and then asked, "What's that?"

If you decide to go out on a barge don't begin by engaging the photographer to take the picture of you and your jewfish in the time-honored pose. You probably won't catch a yellowtail, either, and you may even be passed up entirely. But take along a good big gunny-sack, anyhow, because the chances are that evening will find you (or your wife) ringing your neighbor's doorbells and asking, with your best smile, "Can you use any fish?"

DEER MEAT INVESTIGATION

By H. W. ESTILL, Department of Bacteriology, University of California Medical School, San Francisco

THE PROBLEM of the differentiation of deer from various other meats, for example, goat and beef, is a very real and pressing problem with which the Division of Fish and Game has been confronted for some time. So far as the writer is aware, no entirely satisfactory test has been evolved.

Although some work on the precipitin test has been done in this laboratory in connection with the problem, practically the entire time has been given to a study of the anaphylaxis reaction and in particular the sensitized guinea-pig uterine strip method of Dale.

In the cases where it can be used, no method known to immunology can compare with Dale's technique for the differentiation of closely related proteins, which, of course, is the problem involved. The outstanding merit and value of this method is the exactness and finality with which specific desensitization to various heterologous antigens can be determined. At the same time the Dale reaction is by no means devoid of traps and pitfalls, which is especially true of a problem like this one where meat extracts must be used, for example, a change in pH and toxic effects are items in point.

The blood-serums of the various species involved were first used as possible sensitizing agents and control substances because of the relative ease with which they are obtained and their stability over considerable periods of time. The serums were also used to become familiar with the technique involved before any work was done on the meat extracts. Although it can not be definitely stated, it seems reasonably certain that the blood serums of the deer, goat, beef and sheep can be differentiated from each other. Also it has been quite definitely established that these serums can not be used as sensitizing substances for testing meat extracts.

It was further shown that meat juices (kept constantly in a freezing mixture) of the deer, goat and beef were unsatisfactory as sensitizing and control substances.

Dried raw muscle preparations of the several species are now being tested in the hope that they may be satisfactory standards of reference and will yield proteins which are sufficiently soluble so they can be used as antigens. These preparations consist of the finely pulverized muscle (as free from gross fat as possible) dried first in a current of warm air, then over calcium chloride and finally over phosphorus pentoxide. A 0.9% sodium chloride extract of these preparations is being tested at present and gives evidence that it may be satisfactory.

Although the work on the saline extracts of the raw dried muscle preparations is incomplete, the data furnished by gross shock in the guinea-pig and by the virgin guinea-pig sensitized uterine strip method of Dale suggest that

- (1) these freshly prepared extracts contain enough soluble, unaltered and specific protein to act as a sensitizing medium.

- (2) desensitization can readily be accomplished with heterologous antigens and yet leave sufficient anaphylactic antibody so there is a sharp and definite reaction to the homologous antigen.

- (3) many control guinea-pigs (which received none of the extracts) have shown practically no reaction, in marked contrast to the extract-treated animals.

Work is in progress with regard to such items as appropriate sensitizing and assaulting doses, possible pH changes, and the presence of toxic or histamine-like substances to determine whether this method will be satisfactory.

THE CRUISE OF THE "MAYFLOWER"

By COBURN F. MADDOX, Bureau of Commercial Fisheries, San Diego

DOCKING at her home port, San Diego, May 20, the 135-foot tuna clipper *Mayflower* completed a cruise of some 8000 miles. This is said to be the longest fishing voyage on record and made history in the commercial fishing industry as surely as her famous namesake made American history at Plymouth Rock in 1620.

The *Mayflower*, largest of the local tuna fleet, was built for five partners, Dave and George Campbell Joaquin and Manuel O. Mendina and Sabina Inos. Originally it was planned to use the vessel on long scouting trips for schools of albacore. She is powered with a 550-hp. Union Diesel engine and has a fuel capacity of 25,000 gallons, which gives her a cruising radius of about 8500 miles.



Fig. 61. The *Mayflower*.

Manuel O. Medina conceived the trip to the Hawaiian Islands, though he did not make the voyage. The veteran tuna fisherman, Joaquin O. Medina, captained the crew of fourteen men and acted as navigator on the famous trip. Though they hoped to secure a load of albacore for delivery to the Point Loma plant of the K. Hovden Company, they were unable to sight any of these fish during their cruise.

The *Mayflower* left San Diego March 16th for the vicinity of Magdalena Bay in search of bait. Twenty-two tons of bait, "anchovetas," similar to and about the size of large "quarter oil" sardines, were caught. These small fish are found only at Cape San Lucas or Magdalena Bay, or adjacent waters. They are more desirable for bait than sardines because of their resistance to changes in water temperatures. After getting used to the bait tanks they survive warm water

currents 60 to 100 miles wide, running as high as 87° Fahrenheit—a temperature that would kill sardines.

On April 6th, after experiencing considerable difficulty in securing the desired bait, the vessel left Magdalena Bay on the longest leg of her voyage—Christmas Island. She arrived at this point April 19th, having logged the 3000 miles at an average of 10 knots per hour. From Christmas Island the clipper went to Palmyra, Fanning and New York or Washington Islands and took a few yellowfin tuna at all of these islands, about 45 tons in all. No skipjack were caught.

At Christmas Island they began to be uneasy about their fuel supply and dared not do too much prospecting. Three weeks had been consumed in securing bait, and the auxiliary engines had to be kept running to keep the ice plant in operation, as well as to keep the water in the bait tanks circulating. It is believed, had it not been for this contingency, a much larger catch would have been made.

Being the largest fishing vessel ever to visit the islands, the *Mayflower* created considerable interest when she docked at Honolulu. That she came from so far a point as San Diego added to her fame, and Captain Medina and his crew were most hospitably entertained during their seven days' stay. Two days were devoted to unloading the cargo of 45 tons of tuna, which was delivered to the Hawaiian Tuna Packers, Ltd., of Honolulu, at \$90 per ton. This is a higher price than is being paid by local canners. As there is no bait around Honolulu, Captain Medina had no trouble in getting \$2,000 for that remaining in his tanks. The canners buying this bait sold it to their local fishermen. These fishermen use diesel-operated "sampan"—flat-bottomed boats not unlike those used on the coasts of China and Japan. The Hawaiian boats have bait wells, and the rocking motion of the craft furnishes the necessary circulation of water to keep the bait alive in the tank.

The cruise of the *Mayflower* into Hawaiian waters may revolutionize the tuna industry. Having pioneered the way to unknown fishing banks, the vessel got in touch with a market hitherto unused by California tuna fishermen. When it is considered that the distance from San Diego to Honolulu is 100 miles shorter than to the present southern tuna fishing banks or the Galapagos Islands, and the market somewhat higher, it is not unlikely that a number of our local boats may follow the example of the *Mayflower*.

The main drawback to such a voyage will not be the lack of cruising radius, but rather of bait storage capacity, and the problem of keeping the bait alive and in good condition. Fishermen never know what bait will do in the tank, but after they get used to the tank and feed on the raw fish, which has been ground in a meat grinder, no further trouble is had in keeping them in good condition. They swim in a circle in the tank, their course always to the left. This peculiarity of turning to the left has caused fishermen to term them "left handers." I think this custom of swimming to the left may be due to the fact that the water enters the tank on the port side, in the majority of cases, and the bait swim against the current created by the incoming water.

As the main object of the *Mayflower* is to catch albacore, it is not unlikely our California canners may get to pack this most popular

fish in large quantities, as they did years ago. The owners of the vessel have found they may cruise thousands of miles for this desirable member of the mackerel family and, if not enough can be found, they may fill up their space with yellowfin and skipjack. This they have discovered will find a ready market in Honolulu, and the albacore will always be desirable to California packers.

So much faith have the owners, captain and crew in this idea that they are now off on a second cruise to Hawaiian waters. On their second voyage they obtained bait more readily and expect to reach Honolulu with a good cargo of tuna and, with warmer weather, hope to strike albacore for the California market. They are better equipped for more extensive prospecting than they were on the first trip.

The result of their first trip was noted by the industry with much interest, who are maintaining a still deeper interest in this second cruise of the *Mayflower*, which has, I think, the good will and best wishes of the industry for this progressive venture into little known waters.

CALIFORNIA FISH AND GAME

A publication devoted to the conservation of wild life and published quarterly by the California Division of Fish and Game.

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All material for publication should be sent to Leo K. Wilson, Division of Fish and Game, 450 McAllister Street, San Francisco, California.

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JULY, 1932

No. 3

NATURE'S CARE OF HER OWN

Nature takes loving care of all her own
With marvelous cunning and with watchful eye,
So that her countless brood may multiply,
Nor leave their mother desolate and lone.
To the wild fruits by care of man unknown,
That ripe where winter at his stormiest blows,
She gives more seeds and better than to those
In cultured garden delicately grown.
And so in him that on the rugged breast
Of mountain finds his joy and his repose,
Who makes the pine his fellow, and with zest
Treads the great glaciers and their kindred snows,
A strength is planted, that in direst test
Dares all the devils of danger to oppose.

EDWARD ROBESON TAYLOR.

IMPORTANT NOTICE

Beginning with the current issue for July, 1932, CALIFORNIA FISH AND GAME, the quarterly publication of the Division of Fish and Game of the Department of Natural Resources, will be distributed on a subscription basis for \$1 per year.

This is not an attempt to enter the commercial printing field, but the move is made only because of an overwhelming number of requests from sportsmen and others to be placed on the mailing list.

A free list will be maintained for the benefit of schools, educational institutions and libraries. The magazine will be available for exchange for publications of a similar nature. For accepted contributions, one year's subscription will be furnished free. As the official organ of the Division of Fish and Game, this magazine will be sent free of charge to all officers of the Division and to the heads of other State departments. All others interested will need to pay the subscription fee.

Those who wish to subscribe should fill in the enclosed attached subscription blank and return to this office not later than September 30, 1932, with subscription fee of \$1. Stamps will not be accepted.

Subscriptions will begin with the current July number. This will be the last number distributed unless subscription blanks are returned. Stamps will not be accepted to cover subscription fee.

CHANGE OF ADDRESS

On May 13, 1932, the San Francisco office of the Division of Fish and Game was removed from 510 Russ Building to its handsome new quarters in the State Annex Building, at 450 McAllister Street. From this time forward that address will be the established headquarters of the Division of Fish and Game in San Francisco.

The Los Angeles office, as of date March 30, 1932, was removed from the Associated Realty Building to Room 310, in the new California State Building.

These changes of locale are in line with the policy of the present administration to group all State organizations into the new State buildings.

NEW PATROL ADMINISTRATION

With the start of the eighty-fourth fiscal year, the commercial fisheries patrol, since its inception a separate unit in law enforcement work in the State, has been merged with the activities of the Bureau of Patrol. This transfer was made by the commissioners to effect certain economies in personnel by taking care of the overlapping of patrol activities. E. L. Macaulay will hereafter be in charge of the commercial fisheries patrol as well as the work over which he has presided in the past.

N. B. Scofield will carry on as chief of the Bureau of Commercial Fisheries. Scofield's work, as in the past, will be mainly concerned with scientific investigation and the legislative program concerning this field.

The commercial fishery patrol, while operating as a separate unit under Chief Macaulay and while being accounted for separately in the financial reports of the Division since it is financed by commercial fishing taxes, will cooperate with the commercial fisheries laboratory as it has in the past in the securing of scientific information and the conducting of investigational work.

IN MEMORIAM

GEORGE ALBERT COLEMAN ¹
(1866-1932)

George Albert Coleman died suddenly of a heart attack at Balboa, California, April 28, 1932, while conducting research work for the California Fish and Game Commission. He was accompanied by his wife at the time and had only gone to southern California a few days before to continue investigations at the Salton Sea, where he has been working for some years on the possibilities of establishing the striped bass in that large inland sea. The major part of his life has been spent in the study of entomology and fresh water biology in California. He was reserved,

¹ American Men of Science, ed. 3, p. 137; ed. 4, p. 193, 1927. Berkeley Gazette, p. 20, April 29, 1932.

of a very generous and kindly disposition, and overcame many serious difficulties by patient and conscientious hard work and continuous endeavor. He was born at London, Nebraska, September 24, 1866; at the time of his death he was biologist of the California State Fish and Game Commission and engaged in a biological and ecological survey of lakes and streams in California. This entailed studying the life histories and making collections of aquatic insects, protozoans, rotifers, cladocercas, copeids, ostracods, higher crustaceans, water mites and plant life, as well as the parasites of fishes; also a study of physiological environment in the fish hatcheries and in the streams with a view to bettering cultural practices and food conditions for game fishes.

He served ten years in the U. S. Biological Survey, prior to his graduation from Stanford University with the degree of A.B. in 1903. The degree of A.M. was received from the same institution in 1905, and B.E. and a life diploma from the Nebraska State Normal School, Peru, Nebraska, in 1906. From 1903-1906, also, he was forester and entomologist of the Pacific Improvement Company in California; from 1906-1908, forest supervisor in the U. S. Forest Service; from 1908-1909, biologist, California State Fish and Game Commission; from 1909-1911, horticulturist and entomologist, from 1911-1913, curator of museum and apiculturist, University of California; from 1914-1920, instructor in entomology and apiculture, University of California; from 1914-1920, instructor in entomology and apiculture, University of California; after which he again accepted a position with the State Fish and Game Commission.

Coleman was specially interested in the systematic study of scale insects, Coccidae, and published a number of important papers on the same while at Stanford and the University of California, and did a great amount of work on a monograph of the Coccidae of the world, which he was unable to finish. He also wrote on apiculture. His private exhibit of apicultural methods and way of studying the honeybee in the school-room, accompanied by daily demonstrations with living bees, and weekly lectures delivered to the public at the Panama-Pacific Exposition in San Francisco in 1915-1916, won for him a gold medal and highest praises from the Exposition officials. He also directed and made five reels of motion pictures illustrating the life of the honeybee and beekeeping, one of which is in the Edison Series No. 11. The results of his ecological work have appeared in the Monthly Bulletin of the California State Fish and Game Commission. Among his more important papers may be mentioned the following:

The redwood mealybug (*Dactylopius sequoiae* n. sp.), Calif. Acad. Sci., Proc. (3), Zool., vol. 2, pp. 409-418, pl. xxvii (1901).

Coccidae of the Coniferae, with the descriptions of ten new species from California, Jour. N. Y. Entom. Soc., vol. 11, pp. 61-85, pls. v-vii (1903); suppl. no. 1, vol. 16, pp. 197-198, pls. iv-v (1908).

Beekeeping for the fruit grower and small rancher, or amateur, Calif. Agr. Expt. Sta., Circ. 185, 11 pp., 8 figs. (1917).

He made a collection of birds and mammals in Nebraska, which was exhibited at the New Orleans Exposition in 1884-1885, and also a collection of insects which were given to the University of Nebraska. His large and valuable collection of the Coccidae of the world is the property of Stanford University, to whom he also bequeathed his private library.

Some of the California Coccidae named by Coleman are:

Redwood mealybug, *Pseudococcus sequoiae* (Coleman).

California nutmeg mealybug, *Puto cupressi* (Coleman).

Xylococcus macrocarpae Coleman.

Leucaspis kelloggi (Coleman).

Physokermes taxifoliae Coleman.

Douglas fir scale, *Aspidiotus ehrhorni* Coleman.

Redwood scale, *Aonidia shastae* (Coleman).

Coleman's mealybug, *Pseudococcus colemani* (Ehrhorn), was named for him.

Since 1911 he has made his home in Berkeley, his residence at the time of his death being 2649 Russell Street. He is survived by his widow, Mrs. Florence C. Coleman, and an only daughter, Mrs. Harold V. Heffner, and a grandson, Harold Coleman Heffner, of Chico, California. He was a member of the American Association for the Advancement of Science, the Entomological Society of America, Public Health Association, American Eugenics Society, the California Academy of Sciences, the San Francisco Aquarium Society, the Stanford Alumni Association, and the Thousand Oaks Lodge, No. 478, F. and A. M.—E. O. ESSIG, University of California.

LIFE HISTORY NOTES

A MENDED NEEDLE FISH

A fisherman came to the State Fisheries Laboratory on Terminal Island the other day with a specimen and a puzzled expression. He said that he had been fishing in these waters many years but had never seen the like of the creature he had with him. He wondered if we could identify it.

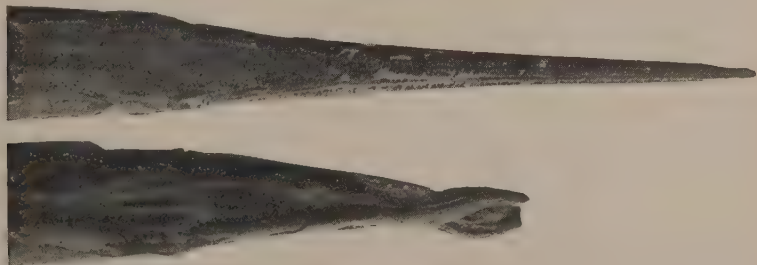


Fig. 62. A needlefish with deformed jaws and a normal individual for comparison.

We had never seen anything like it, either, but the identification was nevertheless not very hard. The object of concern was a needlefish that had met with a bad accident; the end of its long pointed bill was missing. Perhaps it had been bitten off in a fight or perhaps it had been rammed against something. At any rate, it was broken clear off, and what was left was so damaged that the two jaws had set in the peculiar curve shown in the accompanying photograph. The flesh had

healed entirely, and the fish seemed to have been in otherwise good health when it was caught. Unfortunately, when we took the specimen to the window to get a better look at it, the fisherman walked out unnoticed, so we did not learn where or how it was taken.—D. H. Fry, Jr., January 26, 1932.

TWO ECTOPARASITES OF THE CALIFORNIA VALLEY QUAIL

During the latter part of November, 1931, two species of ectoparasites taken from the California valley quail were sent in for identification by Deputy Roswell C. Welch of Kernville. Deputy Welch had discovered the parasites on dead birds while checking quail hunters.

The parasites were identified as a quail louse-fly, *Stilbometopa impressa*, and the common fowl tick, *Argas persicus*.

The louse-fly is a member of the family Hippoboscidae of the order Diptera, or two-winged flies. To this family belong also the common sheep "tick" and deer louse-fly, well known to all who have had anything to do with their hosts. The louse-fly may be winged or the wings may be lacking as in the case of the sheep tick. All the Hippoboscidae are blood suckers and are parasitic on birds and mammals. They do not lay eggs, the larvae being nourished within the body of the female by special glands. When they become ready to pupate they are extruded and the dark brown pupal case forms almost at once. The pupae remain attached to the hairs or feathers on the body of the host. At the end of the pupal period the adult louse-fly emerges and begins feeding at once. In the case of the wingless forms the entire life history is passed on the body of the host. Little is known of the biology of the louse-fly and the winged forms are rare in entomological collections.

It is improbable that the quail louse-fly due to its blood sucking habit alone is responsible for any serious amount of injury to our quail population. It may, however, be an important factor in the spread of disease. *Lynchia hirsutus*, another louse-fly from the valley quail, has been implicated in the transmission of *Haemoproteus lophortyx*, a blood parasite of that bird.

With regard to the other parasite, *Argas persicus*, this is not the first time that it has been reported from quail in California. It has also been reported from the western mourning dove. The instances in which this tick has been taken from wild species of birds are relatively rare, since it is commonly a parasite of poultry and is in its element in the henhouse. It is not likely that it will ever become a serious pest of quail.—GORDON H. TRUE, JR.

THE PRONGHORN ANTELOPE

The game warden of the county of Los Angeles has land under his protection where roam some of the last of the once numerous pronghorn antelope. The pronghorn antelope range in scattered remnants throughout California, Arizona, New Mexico, Texas, Nevada, Utah, Colorado, Idaho, Montana, North and South Dakota and Nebraska. In Los Angeles County the last few members of one of the most graceful of animal groups are living in the valley to which they have given their name—Antelope Valley.

In the present herd there were counted on March 13th of this year (1932) seven individuals: one large buck, five does and one individual

smaller than the rest that looks like a yearling doe. These comprise the last of a herd that numbered, according to old residents of the region, as high as five to six hundred animals forty years ago in the same region. As with other natural resources, man has been careless with the preservation of these animals. The large Tejon Ranch, on which they range for the most part on low hills and flat grass lands, now supplies them with a moderate amount of protection.

Their great weakness which has accounted for most dead antelope, is their curiosity. When startled they will run swiftly for a couple of hundred yards and then turn and face the pursuer. They can be attracted by waving a flag or by the old Indian method of lying on one's back and waving the legs. By such methods they are easily brought within gunshot.

The pronghorn antelope is the only living species of its kind and fossil remains show it to be one of the oldest of American quadrupeds. When the last pronghorn is gone, there will be no creature like it left on the earth.—HARVEY T. ANDERSON, JR., Junior Assistant Fire and Game Warden, County of Los Angeles.

ON THE DESERT

While walking along a desert trail near Snow Creek in Riverside County, one of the desert killers was seen in action. A king snake was observed just after he had seized a water snake by winding three coils of his body around that of the water snake. These coils were about three-fourths of the way back from the water snake's head and consisted of a half-hitch and two direct coils.

The king had apparently just captured his prey and was deliberately proceeding to reduce its resistance sufficiently so that he could utilize it for food. The king snake was about twenty-two inches long and the water snake two or three inches shorter.

The king wore down his antagonist by winding its head around and around the body in ever tightening coils. Each coil was drawn up and tightened separately and, except for the three original coils, were about one inch apart. When the series of coils neared the water snake's head the king seized its neck in his jaws. This hold was continued until the water snake's muscles commenced to relax when he released his hold and tried to seize its head in his mouth. Just at this moment the water snake opened its mouth and king seized the lower jaw only; the water snake closed down on the king's upper jaw and they remained locked in this position for several minutes.

Eventually the water snake's jaws relaxed and the king viciously tore loose his hold and reaching his head around in front of the other's head seized the snout of the water snake in his capacious jaws.

Immediately the king commenced a swallowing process by extending its jaws and neck muscles and gradually pulling the head and body of the water snake into its mouth. He apparently took advantage of each spasmodic muscular movement of his victim, releasing the coils which he had wound around the other's body as the swallowing performance continued. When the three original coils were reached these were loosed quickly and the remaining portion of the water snake's body and tail rapidly disappeared down the king's throat.

During the swallowing process several attempts were made to distract the king's attention by grasping the water snake by the tail and holding them up off the ground, but the king paid no attention and continued cruelly in subduing the other.

After the king had finished swallowing the water snake he was ready for battle and viciously resented any interference with his journey into some leaves at the base of a cactus bush. After waiting several minutes the leaves under which he had crawled were carefully raised and the king was lying comfortably coiled but with head up and tongue darting showing resentment of any interference and a fear that his hard earned repast might yet be taken from him.

This circumstance was witnessed by D. A. Clanton and A. E. Burghdoff, October 25, 1931.

COMMERCIAL FISHERY NOTES

An illustration of the value of investigations in connection with fisheries conservation was given by N. B. Scofield in a talk on size limits, before the recent San Francisco conference of deputies.

As a result of an investigation of the commercial crab carried on a little over 20 years ago by Frank W. Weymouth, of Stanford University, when the San Francisco crab fishery was declining and fishermen believed the minimum size limit of six inches was too high, it was shown that the size limit was too low, as it did not protect the male crabs until after they had a chance to breed. With the evidence obtained it was easy to convince the Legislature that the minimum size should be raised to seven inches.

A few years later, when the first crop of crabs under the protection of this new law reached the seven-inch size, the production of the fishery suddenly doubled, and since then has increased until the fishery produces annually 75,000 dozen more crabs than it did before the law was changed. This increase in production is worth \$185,000 annually to the fishermen—or more than the average annual budget of the Bureau of Commercial Fisheries.—N. B. S.

FISHING CONDITIONS, MONTEREY COUNTY

Along the rocky coast line between Monterey and the Big Sur more sports fishermen are engaged in salt water fishing this season than in any previous year. Rockcod, bluefish and sculpins are the gamest of the fish caught along this coast line and considerable fishing tackle is being sold by local hardware dealers. The bait used is sardines and abalone trimmings, and good catches are made during the incoming tides.

The local office of the Division receives many calls and letters regarding salt water fishing in Monterey Bay, and over the week-end and holidays two or three hundred anglers are in boats salt water fishing.—RALPH F. CLASSIC, Monterey, California.

The California State Board of Public Health on May 28th issued new shellfish regulations as follows:

PERMANENT QUARANTINE ON CLAMS IN SAN FRANCISCO BAY

By reason of sewage pollution of San Francisco Bay and consequential danger of typhoid fever and gastro-enteritis, a permanent quarantine is hereby established, prohibiting the taking, sale or offering for sale of all clams, including soft shell or mud clams from San Francisco Bay and tributary sloughs in the counties of Alameda, San Francisco, San Mateo, Santa Clara, Contra Costa, Solano, Sonoma and Marin, except at the following places in Marin County:

- (a) For one mile each side of California Point.
- (b) The south shore of Tiburon Peninsula on Richardson Bay for one mile north of Belvedere.
- (c) Between McNear Point and Gallinas Creek northerly from McNear Point.

SEASONAL QUARANTINE ON RAZOR CLAMS AND MUSSELS FROM MONTEREY COUNTY TO THE KLAMATH RIVER IN DEL NORTE COUNTY

By reason of the toxicity of razor clams and mussels, a seasonal quarantine each year is established, prohibiting the taking, sale or offering for sale of razor clams and mussels from the coastal area of California extending from Monterey County to the Klamath River in Del Norte County, with the exception of the Bay of San Francisco. The duration of the quarantine is to be determined each year by laboratory tests for toxicity. For the year 1932, the quarantine is hereby made effective May 28th to continue through September 30th.

A seasonal quarantine is hereby authorized prohibiting the taking, sale or offering for sale of quahaug clams, cockles, Washington clams, horseneck clams and soft shell or mud clams as soon as toxicity has been demonstrated. The quarantine, hereby authorized, covers the coastal area of California from Monterey County to the Klamath River in Del Norte County. In order to execute this order each dealer gathering the above clams is hereby required to submit samples of each variety—such samples to be taken at weekly intervals each year during the months of May, June, July, August and September.

Dr. Frank W. Weymouth, in charge of the shrimp investigation for the U. S. Bureau of Fisheries, was a visitor at the California State Fisheries Laboratory on May 2d, at which time he discussed fisheries conservation work with W. L. Seofield and other members of the staff, as well as relating the progress that has been made in the work on shrimps. Dr. Weymouth was on his way from Stanford University to New Orleans to resume active supervision. For the past few months, Dr. Weymouth has been at Stanford University, during which time Milton J. Lindner, former staff member of the laboratory, has been directing the scientific program.

This investigation, commenced in 1930 by the U. S. Bureau of Fisheries, in which three gulf States—Louisiana, Texas and Georgia—are cooperating, will take several years to complete, according to Dr. Weymouth. The shrimp industry is an important one in the

United States, ranking fifth in value and sixth in volume in comparison with other fisheries, but until the formation of the present extensive program no adequate study has ever been made of the shrimps.

On May 5 and 7, 1932, Dr. Cecil von Bonde, Director of the Fisheries and Marine Biological Survey for the Union of South Africa, was at the California State Fisheries Laboratory to consult with W. L. Scofield, and gave interesting accounts to the members of the laboratory of the fisheries resources in South Africa and what is being done in investigating the potential fishing areas and in carrying out marine research for the further development of the fisheries. Dr. von Bonde is on an extensive tour of the United States and Europe to study methods of fisheries investigations used by various countries. He has already been in the eastern part of the United States, and while in Washington, D. C., conferred with Henry O'Malley, U. S. Commissioner of Fisheries, Elmer Higgins and other members of the U. S. Bureau of Fisheries staff. While in southern California he also visited the Scripps Institution of Oceanography at La Jolla. On May 8th Dr. von Bonde left for the State of Washington, and later intends to go to Europe for a stay of a few months before returning to South Africa.

BIG-EYED BASS AND STRIPED BASS

In the October, 1931, issue of the California Fish and Game appeared a note that striped bass were taken by sport fishermen at San Clemente. Howard R. Hill, of the Los Angeles Museum, has since written to say that the fish, on further study, proved instead to be the young of the big-eyed bass (*Xenistius californiensis*). That people may not confuse these two fishes, the following brief description is given of the big-eyed bass.

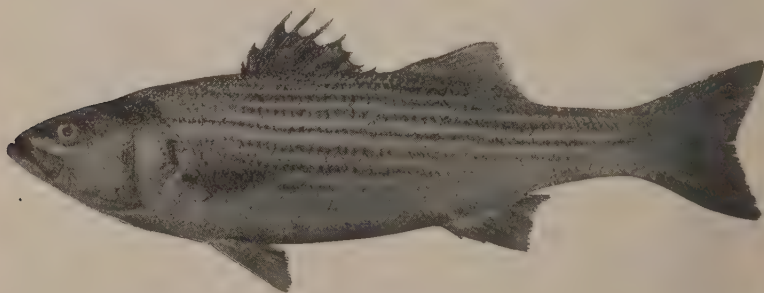


Fig. 63. Striped Bass (*Roccus lineatus*.) The eye of the striped bass is proportionately much smaller than that of the big-eyed bass, being much less than one-third the length of the head, and the pectoral fin does not reach beyond the tips of the ventrals.

Relationship: The only fish of the snapper family (Lutianidae) which occurs in California. The family is a large one, its members inhabiting warm seas throughout the world. Many species, some of them of increasing commercial importance, occur in Lower California.

Distinguishing characteristics: There are no teeth on the vomer (that is, in the center of the roof of the mouth); the upper part of the maxillary bone is covered by the bones just above it; the eye is large, being a little less than one-third the length of the head; the pectoral fins extend farther back than the tips of the ventral fins.

Color: Metallic bluish above, silvery on the sides and below; back and sides with six or seven horizontal, orange-brown stripes. Attains a length of about a foot.

Distribution: San Pedro southward, into the Gulf of California to Guaymas, Mexico; not common north of Lower California.—LIONEL A. WALFORD, California State Fisheries Laboratory, February, 1932.



Fig. 64. Big-eye Bass (*Xenistius californiensis*.)

DIVISION ACTIVITIES

BUREAU OF FINANCE

Though April started out with very bright prospects for a prosperous business in angling licenses, the unfavorable climatic conditions caused a dropping off during May and the income from this source was not up to former years. However, with the assurances there are plenty of fish in the lakes and streams, and with more favorable weather, a brisk business was experienced during June.

The unsettled economic conditions are being felt on the income of the Division of Fish and Game. Judges are disposed to be more lenient in assessing fines on game law violators, and giving as well, time to pay such fines as are levied. This increases the work of this bureau.

Licenses issued to credit dealers are being kept at as small a number as possible, owing to requests from the bonding companies covering these licenses.

Fish packers' tax and fines have fallen off, although all packers are paying promptly with but one exception.

The bureau has also taken over the larger field of direct distribution of licenses, formerly handled by county clerks.

An order has been placed for 320,000 metal deer tags, and 160,000 cardboard tags for distribution when the deer season opens.

BUREAU OF GAME REFUGES

Early indications that the present year, on account of the abundance of rain, would prove a successful one on the migratory waterfowl refuges have proven true. Ducks nested well on the Gray Lodge Refuge near Gridley, nests being found on almost every section of the place.

The San Joaquin area reports all the more common species of ducks were found taking advantage of the excellent water conditions, the best for ten years.

On the Suisun refuge the number of sprig nesting there was surprising as were they on Gray Lodge and at Los Banos.

Reports show a good crop of ducks will be hatched on Buena Vista Lake and in the Kings River area.

By raising the water level at the Imperial Refuge thirty inches, thus stopping spreading of tule growth, a larger surface will be afforded migratory birds for a loafing place.

One of the most devastating predators the Los Banos Refuge had to contend with was the house cat gone wild. These animals were destroying the nests of the waterfowl, but with the killing of 51 this hazard is believed to have been eliminated.

Los Banos reports great numbers of geese—Hutchins and cackling. Although there have been some egg lays the females don't seem to be interested in raising families.

At Gray Lodge a good crop of mallards have materialized from the domesticated birds and wild domesticated mallards have laid well at Los Banos, but their eggs do not seem to be so fertile.

Quail results throughout the State are good and many refuges are being posted, especially in southern California and that area south of San Francisco.

The eight predatory animal trappers have made it tough for coyotes and bobcats. The report for the year so far on waterfowl refuges shows 130 coyotes and 108 bobcats killed.

Lion hunters for the year to June 1 have turned in 159 scalps, 14 more than at this time in 1931. May was a big month—13 females and 12 males being killed, 4 over last year. April was a dull month for lion hunters. They only bagged 13, but for March they turned in 39 scalps, 20 of which were from females. The kill in March, 1931, was 29.

To date this year, 345 game breeders have taken out licenses.

The fur animal raisers have filed their annual report and show a great falling off, as the prices have been less than half of last year and still less than prices for pelts in 1930.

The State Department of Public Works has let the contract for fencing the Kern County Elk Refuge. The rate was \$700 per mile for the metal posts and wire necessary for the seven-foot fence. The Anchor Post Fence Company was the successful bidder.

BUREAU OF HYDRAULICS

This bureau has devoted considerable time to keeping free from pollution many streams noted for game fish. Dredges on the Merced and Tuolumne rivers have cooperated to keep the waters clear and have followed suggestions from the head of this bureau.

John Spencer, chief of the bureau, attended the meeting of the California Sewage Workers Association held in Yosemite May 20. He also took part in the deliberations of the State Chamber of Commerce which resulted in the Benbow company agreeing to put in a proper fish ladder in their power dam.

A survey was made of the proposed site for a commercial hatchery on Bull Creek to be operated by a Mr. Rothermud. Reports of this survey have been forwarded to the Bureau of Fish Culture.

The Sierra Power Company has installed a parallel bar screen on the Truckee River at Floriston.

Appearances in courts totaled over 125; and maps, plans and sketches prepared for the department amounted to over 500 in the three months just passed.

BUREAU OF GAME FARMS

March found the game farms all set for the annual egg laying season. Pens had been cleaned, plowed, sowed and otherwise made habitable for the selected brood stocks that were to be placed in them.

The demand for game bird eggs was heavier than in any former season, and the allotment of 30,000 ring-necked pheasants was spoken for long before the height of the egg laying.

The quail egg crop was splendid, showing an increase over past years. As this species of bird is to be distributed more in southern California, the eggs gathered at the Yountville Game Farm were sent to the Los Serranos Game Farm, at Chino.

Interest in raising pheasants, turkeys and quail has shown a marked increase.

In Petaluma, the hatching plant handling pheasant eggs turned out a high percentage of chicks and these birds when at the proper age are to be distributed in Marin and Sonoma counties.

In the San Joaquin Valley section, great success has attended the efforts of sportsmen's organizations in raising pheasants, and they have been properly distributed.

The new Jamesway incubating plant has proven its worth and added to the convenience and production facilities of the Yountville farm.

Superintendent August Bade is lending every assistance to James Moffitt and A. W. Elder in inspecting and selecting sites for quail sanctuaries offered by public-spirited landowners. To date six sanctuaries, four in the south and two in the north, are expected to be posted and under proper supervision of the Fish and Game Commission by the end of June. Others will follow.

The Game Farm, at Yountville, has afforded work to several local families, thus contributing its part toward lessening the depression.

BUREAU OF COMMERCIAL FISHERIES

The closing of the sardine season in southern and northern California waters in March was followed by the opening of the salmon and tuna season in April.

In southern California, the five sardine plants reported an increase of 4000 tons over the 1931 season. Most of the cannery inspectors have been laid off. In Monterey some canners are experimenting with a new pack, using agar-agar jelly which dispels the fishy odors and keeps the sardines more solidly packed.

Low prices of salmon have kept many fishing boats from going to sea. In Eureka, but a small portion of the 125 trollers have gone for fish, and those that did brought in small catches as compared to former seasons. Salmon running from 10 to 12 inches were brought in by half the salmon fishing fleet that sail out from Noyo. The boats report as high as 400 pounds of salmon per vessel.

In the Shasta area, reports were received that many spawning beds were destroyed by overcrowding. A survey was made to determine how large the loss is.

The migration of salmon fingerlings, which ended May 15, was heavy this year.

Sacramento and San Joaquin rivers report a good run of shad, but prices dropped considerably. There was a good eastern market that made conditions desirable.

San Pedro and San Diego canneries started operating in April with the opening of the tuna season. Nine of the 11 major tuna canneries have formed a cooperative association, known as the Tuna Canners Institute. The purpose is to prevent overproduction and endeavor to promote the widest market for this commodity. Sardine canners are planning a similar organization.

There was some trouble about prices between the tuna fishermen and canners at the beginning of the season, with the result there was a one-third dropping off of the tonnage delivered during the opening month. However, as the trouble has been settled, it is expected this decrease will more than be made up.

From January to June 1, 3,500,000 pounds of mackerel were delivered to the canneries.

The Bayside Fish Flour Company, of Monterey, made formal application for a permit to manufacture 20,000 tons of fish flour. They intend to erect a new plant in Richmond.

Low prices for the fresh fish caused dealers to give away tons of yellowtail brought from Mexican waters to San Pedro. This bureau gave a half-ton of confiscated tuna to the Whittier State School.

Harvey McMillin and Paul Bonnot have made an extensive survey of oyster lands along the California coast. All lands available for oyster culture have been filed on.

McMillin went to Eureka April 7 to remain until July 1. In Humboldt Bay it has been found native oysters thrive and mature in much less time than in more northern waters. McMillin and Bonnot supervised the installation of the first dikes on the California coast for the protection of oysters from climatic changes and to keep sufficient water over the oyster beds during low tide. This dike was built in North Humboldt Bay. Experiments were also carried on in Newport and

Morro bays and Mugu lagoon in oyster planting. The planting of 370 boxes of Japanese oyster "seed" in Elkhorn slough was another accomplishment of these experts. It has been proven that the Japanese oysters in Elkhorn mature in less than half the time taken in their native waters, and that they are richer in protein food value than oysters found in any place in the world.

Cooperating with Dr. J. O. Snyder, of the Bureau of Fish Culture, this bureau is working out a record form by which it is hoped a check may be kept of fish caught by sportsmen from ocean piers, surfs, charter party and fishing barges. From results obtained so far in the experiment, it has been found that sports fishermen in the Los Angeles area caught as many fish as the commercial fresh fishermen.

Small catches marked the opening of the salmon trolling season April 1.

Squid catches in the Monterey district fell off one-half over former years. All dried on the beach for Chinese trade; none were prepared for Italian trade.

The patrol boat *Bluefin*, after being put in repair, made a survey trip to determine the definite maximum sardine spawning area. This was found to be from the Mexican border to Point Conception and extending 100 miles out to sea.

During April, the patrol boat *Albacore* weekly aided the hydrobiological survey in its work along the northern coast, and patrolled as far north as Point Reyes. The crew also put the small boat *Steelhead* in condition.

BUREAU OF FISH CULTURE

Severe weather in the early part of the second quarter of 1932 with high water running in many streams, delayed fish egg gathering somewhat, but by the end of the season, around May 31, the work had been well done. The "take" of eggs this year was very satisfactory, many species of trout showing a marked increase, others holding their own. However, the eggs of the rainbow this year fell a couple of million less than the average. This loss is made up, however, by the increase of other varieties, and will not lessen the supply available for the anglers.

After much planning, the new experimental hatching and rearing ponds for black bass at Friant, Fresno County, has been completed by the Department of Public Works and turned over to the Division of Fish and Game. Already, a small supply of small-mouth black bass has been transferred to the ponds from Stockton as brood stock, and several thousand golden shiners to furnish food for the bass received from San Diego.

Minor defects are being remedied and the experiment is being given every encouragement. Merrill W. Brown has been placed in charge with Carlton Rogers, as assistant.

During April, a shipment of 28,000 Atlantic salmon eggs were received at the Mt. Shasta Hatchery from the Canadian Department of Marine Fisheries.

There was great activity in all the hatcheries during the past three-months period, seeing the trout eggs were given the proper attention.

The hatch was above normal, assuring a good supply of sport fish for the streams and lakes of this State for future seasons.

Plans were started in June for the annual planting in trout waters, and the anglers are assured of some 35,000,000 of these game fish for the streams and lakes, while the salmon plant will increase the fish planting to some 40,000,000 for 1932.

BUREAU OF FISH RESCUE AND RECLAMATION

March was a light month for this bureau, but its personnel was busy in May, rescuing and moving nearly 2,000,000 large-mouth black bass. This action was made necessary on account of the cannibalistic tendency of this species of game fish—the parent fish eating the young, sometimes when they are 30 days of age.

The young fish rescued were taken to permanent waters, away from their native haunts, where conditions would be ideal for their maturity.

Sports fishermen are continually increasing their demands for black bass, to the exclusion of other species of spiny-rayed game fish.

The total of fish rescued for May was 1,842,861. For April, the total was 390,430. The receding waters of many streams made it necessary for this bureau to take prompt action to save these thousands of fish for the anglers.

In line with the policy of the Division of Fish and Game, many nongame fish were caught, destroyed or given away.

BUREAU OF PATROL

A change in the attitude of magistrates toward violators of the fish and game laws has been very noticeable during the second quarter of this year. While justices of the peace are convinced the laws should be enforced and arrests made, they seem inclined toward leniency when it comes to fining those arrested. They seem to feel that during the depression it would be well to go a little easy on those who have not violated the game laws too glaringly. In one month, out of 206 arrests, 57 defendants found guilty were given suspended sentences.

With the opening of the trout season May 1, the usual number of anglers were found without a fishing license. Forty-five of these were arrested by deputies. Sixteen arrests grew out of the fact of fishermen being unable to read, or at least they did not pay any attention to the signs posted, declaring certain streams and lakes closed to fishing.

Arrests and money collected as fines fell considerably below the total for March, April and May. For the period from January 1 to May 31, 1931, \$73,000 in fines were collected; for a like period this year, only \$46,070.

Deer meat possessors to the number of 34 were arrested, and fined or jailed for having venison in their possession out of season.

The bureau heads are busy trading in automobiles owned by the State and used by the patrol since 1930. In purchasing new autos, small type cars with closed cabs and pick-up bodies are being favored.

VOLUNTEER DEPUTIES

Volunteer deputies have taken great interest in the work of establishing quail sanctuaries throughout the State, and have aided in posting some 15,000 acres of land set aside for the propagation of this noted game bird. The sanctuaries that make up this acreage are located in San Diego, San Mateo, Tulare and San Joaquin counties.

Reports from the volunteers indicated that during the mating season the quail paired off splendidly, nested well and that there was a good hatch.

Captain John Warman of the San Joaquin area writes in to say there were 250 pairs of quail on one ranch set aside as a sanctuary.

Following the policy of the Fish and Game Commissioners to keep the list of volunteer deputies to as small a number as possible, Captain Walter Welch has been busy weeding out those who have shown no great interest in fish and game conservation and in the enforcement of the laws of the division. The reduction of the ranks has been accomplished in a manner that has aroused no ill feeling among those sponsoring the deputies dropped.

The volunteer deputies did much work prior to the opening of the trout season, preventing fishing before May 1. Many angling licenses were checked and a number of arrests were credited to men of this bureau.

Predatory birds and animals in large numbers fell before the fire of the volunteer deputies during the past three months.

BUREAU OF EDUCATION AND RESEARCH

Some of the outstanding work of the Bureau of Education and Research was confined to the wild life displays and the visual education exhibits. E. S. Cheney erected an exhibit booth at the Butte Council of the Boy Scouts of America exhibit which was held at Marysville the latter part of April. In addition to this, exhibit assistance was rendered by this bureau in the installation of an exhibit in the windows of the Pacific States Savings and Loan Association. This exhibit is a traveling one and will be shown in the principal cities in northern California.

The rapid growth of the mailing list of CALIFORNIA FISH AND GAME necessitated a change in the method of distribution from the old complimentary system to that of a subscription basis. Details of this project were worked out by the Department of Finance and the system became functional with the current issue.

An elaborate investigation of the effect of rodent control on quail populations was conducted by Ira Gabrielson, of the U. S. Bureau of Biological Survey, W. C. Jacobsen, of the State Department of Agriculture, and Leo K. Wilson, of this bureau. This work was done in Monterey and Kings counties.

Gordon H. True, Jr., completed the work undertaken by James Moffitt on the effect of predatory animals upon the nesting waterfowl population in northeastern California. This work will be the basis of a report to be published in the near future by James Moffitt.

REPORTS

SEIZURES OF FISH AND GAME

January, February, March, 1932

Fish:

Abalones	1,062
Bass, striped, pounds	1,150
Bass, striped (fish)	195
Crappie, perch, sunfish	41
Crabs	316
Clams	1,537
Lobsters	224
Lobsters, pounds	1,289
Nets, illegal	1
Miscellaneous fish	306
Mussels, pounds	496
Steelhead	536
Spears, illegal	5
Salmon, pounds	134
Trout	56
Traps, fish	32

Game:

Deer	14
Deer meat, pounds	721
Deer hides	23
Doves	5
Ducks, geese and mudhens	728
Elk meat, pounds	55
Non-game birds	171
Pigeons	33
Pheasants	10
Quail	20
Rabbits	19
Shorebirds	32
Wood ducks	1
Skins, fur bearing animals	7
Trap, bird	1

FISH CASES

January, February, March, 1932

	Number arrests	Fines imposed	Jail sentences (days)
Angling License Act; violations of	44	\$578 00	64
Abalones; closed season; small	46	580 00	60
Bass—			
Striped, small; netting of	12	350 00	
Black, small	1	100 00	
Clams; small, overlimit	53	740 00	185
Crabs; small; female	12	770 00	5
Commercial Fishing License Act; violations of	31	320 00	25
Illegal fishing apparatus	10	240 00	130
Fishing in refuge	2		
Lobsters; small	15	205 00	53
Mussels; overlimit	28		336
Nets; seines; illegal	33	1,017 00	358
Perch, crappie, sunfish; closed season	12	243 00	36
Pollution	1		
Salmon in closed district	1	50 00	
Spears, illegal	4	40 00	
Trout; steelhead	16	435 00	25
Traps, fish	2		
Yellowfin; selling of	1	10 00	
Taking marine life from Hopkins Marine Life Refuge	3	5 00	
Totals	327	\$5,683 00	1,277

GAME CASES

January, February, March, 1932

	Number arrests	Fines imposed	Jail sentences (days)
Deer; closed season.....	89	\$1,496 00	1,272
Ducks, geese, mudhens; closed season.....	25	533 00	311
Doves; closed season.....	1	25 00	—
Hunting License Act; violations of.....	14	338 50	3
Hunting on refuge.....	5	100 00	3
Non-game birds; killing of.....	39	862 50	11
Night hunting.....	1	—	—
Pigeons; closed season.....	22	495 00	—
Pheasants; closed season.....	11	383 00	286
Quail; closed season.....	9	145 00	—
Rabbits; closed season.....	6	100 00	—
Squirrel; closed season.....	2	—	—
Shipping wild game by parcel post.....	1	50 00	—
Traps (bird); illegal use.....	1	—	—
Trespassing.....	3	30 00	—
Trapping License Act.....	2	40 00	—
Totals.....	231	\$4,598 00	1,886

STATEMENT OF EXPENDITURES

For the Period July 1, 1931, to March 31, 1932, of the Eighty-third Fiscal Year

Function	Salaries and wages	Materials and supplies	Service and expense	Property and equipment	Total
Bureau administration:					
Executive.....	\$6,600 00				\$6,600 00
Clerical and office.....	16,603 23	\$862 97	\$320 92	\$171 26	17,958 38
Printing.....		17,426 25			17,426 25
Automobiles.....		225 79	213 54		439 33
Traveling.....			2,595 90		2,595 90
Postage.....			4,026 78		4,026 78
Telephone and telegraph.....			3,370 38		3,370 38
Freight, cartage, and express.....			2,057 93		2,057 93
Rent.....			11,435 95		11,435 95
Accident and death claims.....			2,885 32		2,885 32
Accounting pro rata.....	3,375 00				3,375 00
Legal.....	4,950 00		718 37	182 46	5,850 83
Premiums on bonds.....			87 50		87 50
Publicity.....			68 86		68 86
Total bureau administration.....	\$31,528 23	\$18,515 01	\$27,781 45	\$353 72	\$78,178 41
Bureau education and research:					
Chief and assistants.....	\$4,612 94				\$4,612 94
Clerical and office.....	1,962 05	\$163 71	\$230 80	\$26 70	2,383 26
Traveling.....			4,724 74		4,724 74
Telephone and telegraph.....			16 78		16 78
Freight, cartage and express.....			4 10		4 10
Photographer.....	1,080 00		141 04	1,190 32	2,411 36
Librarian.....	1,530 00	23 08	113 10	101 13	1,767 31
Research.....	8,144 68	310 08		28 00	8,482 76
Blue printing.....			12 66		12 66
Publicity.....			518 32		518 32
Exhibits.....			8 25		8 25
Lecturer.....	2,835 00				2,835 00
Temporary help.....	18 63				18 63
Total bureau education and research.....	\$20,183 30	\$496 87	\$5,769 79	\$1,346 15	\$27,796 11
Bureau patrol and law enforcement:					
Chief and assistants.....	\$8,295 00				\$8,295 00
Clerical and office.....	2,415 32	\$70 32	\$17 91	\$11 47	2,515 02
Automobiles.....		6,550 20	3,134 29	1,286 14	10,970 63
Traveling.....			95,120 66		95,120 66
Postage.....			331 07		331 07
Telephone and telegraph.....			1,517 93		1,517 93
Freight, cartage and express.....			45 95		45 95
Rent.....			461 85		461 85
Heat, light and power.....			21 27		21 27
Captains and deputies.....	156,492 99	1,634 38	405 13	291 65	158,824 15
Launches.....		2,138 07	850 39	46 33	3,034 79
Fish planting.....	4,922 72	539 81	226 00		5,688 53
Volunteer deputies.....	440 00				440 00
Premiums on bonds.....			2,215 48		2,215 48
Temporary help.....	30 00				30 00
Cooks.....	1,536 29				1,536 29
Total bureau patrol and law enforcement.....	\$174,132 32	\$10,832 78	\$104,347 93	\$1,635 59	\$291,048 62
Bureau commercial fisheries:					
Chief and assistants.....	\$12,075 00			\$41 00	\$12,116 00
Clerical and office.....	7,964 72	\$230 92	\$97 42	8 60	8,301 66
Automobiles.....		566 46	242 12		808 58
Traveling.....			16,242 84		16,242 84
Postage.....			3 52		3 52
Telephone and telegraph.....			495 47		495 47
Freight, cartage and express.....			476 50		476 50
Rent.....			890 68		890 68
Heat, light and power.....			310 50		310 50
Research.....	6,863 09	78 61		80 90	7,022 60
Captains and deputies.....	12,590 00	141 05	36 57	10 00	12,777 62
Launches.....	9,410 00	3,670 41	1,965 52	228 35	15,283 28
Laboratory.....	23,435 19	541 91	1,159 90	593 65	25,730 65
Blue Printing.....			5 94		5 94
Hydro-biological survey—Monterey Bay.....			750 00		750 00
Statistics.....		696 19	1,355 67	48 15	2,100 01
Fish cannery research.....			11,250 00		11,250 00
Fish cannery inspectors—seasonal.....	15,040 55				15,040 55
Total bureau commercial fisheries.....	\$87,378 55	\$5,934 55	\$35,282 65	\$1,010 65	\$129,606 40

STATEMENT OF EXPENDITURES

For the Period July 1, 1931, to March 31, 1932, of the Eighty-third Fiscal Year—Continued

Function	Salaries and wages	Materials and supplies	Service and expense	Property and equipment	Total
Bureau fish culture:					
Chief and assistants	\$6,910 00				\$6,910 00
Clerical and office	3,099 67	\$182 32	\$30 35	\$85 05	3,397 39
Automobiles		3,703 78	1,752 91	1,748 80	7,205 49
Traveling			7,578 99		7,578 99
Postage			76 67		76 67
Telephone and telegraph			812 48		812 48
Freight, cartage and express			834 68		834 68
Rent			1,225 84		1,225 84
Heat, light and power			878 78		878 78
Hatcheries	84,448 58	38,196 66	1,020 43	1,834 19	125,499 86
Special field investigations	7,788 66	173 83	20 19	7 25	7,989 93
Fish cars	2,655 00	212 46	881 83	2 95	3,752 24
Blue printing			84 95		84 95
Cooperative research	1,068 50	43 75	582 24	182 85	1,877 34
Fish hatchery assistant—seasonal	17,818 02				17,818 02
Total bureau fish culture	\$123,788 43	\$42,512 80	\$15,730 14	\$3,861 09	\$185,892 46
Bureau hydraulics:					
Chief and assistants	\$6,255 00		\$25 66		\$6,280 66
Clerical and office		\$21 89	40 19		62 08
Automobiles		322 80	214 56		537 36
Traveling			1,679 25		1,679 25
Postage			1 00		1 00
Telephone and telegraph			6 20		6 80
Cooperative research	2,250 00				2,250 00
Total bureau hydraulics	\$8,505 00	\$344 69	\$1,967 46		\$10,817 15
Bureau game propagation:					
Superintendents	\$2,475 00				\$2,475 00
Clerical and office	40 00				40 00
Automobiles		\$351 64	\$117 30		468 94
Traveling			1,512 19		1,512 19
Postage			5 00		5 00
Telephone and telegraph			202 49		202 49
Freight, cartage and express			23 72		23 72
Heat, light and power			536 72		536 72
Maintenance		7,356 01	796 85	\$2,116 09	10,268 93
Assistants	10,149 15				10,149 15
Total bureau game propagation	\$12,664 15	\$7,707 65	\$3,194 25	\$2,116 09	\$25,682 14
Bureau fish rescue:					
Chief and assistants	\$3,790 00		\$176 72	\$35 00	\$4,001 72
Traveling			1,659 30		1,659 30
Rent			180 00		180 00
Total bureau fish rescue	\$3,790 00		\$1,996 02	\$35 00	\$5,821 02
Bureau game refuge:					
Chief and assistants	\$6,374 97				\$6,374 97
Clerical and office	1,440 00	\$31 29			1,471 29
Automobiles		694 85	\$262 53		957 38
Traveling			3,176 83		3,176 83
Postage			1 97		1 97
Telephone and telegraph			17 75		17 75
Freight, cartage and express			50		50
Lion hunters and trappers	5,658 88				5,658 88
Refuge posting		122 91	252 60	\$863 04	1,238 55
Predatory animal control			5,880 00		5,880 00
Temporary help	10,528 85				10,528 85
Refuge maintenance	4,125 00	3,397 92	2,065 71	54 00	9,642 63
Total bureau game refuge	\$28,127 70	\$4,246 97	\$11,757 89	\$917 04	\$45,049 60

STATEMENT OF EXPENDITURES

For the Period July 1, 1931, to March 31, 1932, of the Eighty-third Fiscal Year—Continued

Function	Total
Construction, improvements and equipment:	
Telephone and power line from Chester to Lake Almanor Fish Hatchery.....	\$2,400 00
Improvements at Lake Almanor Hatchery.....	1,391 55
Filter at Big Creek Hatchery.....	141 85
Permanent repairs on Brookdale Hatchery.....	761 30
Construction of dams on Cherry Creek.....	1,000 00
Completion of egg collecting racks at Chester.....	601 16
Construction of rearing ponds and a temporary house for an attendant, Hat Creek, Inyo County.....	1,245 18
Tank and egg collecting station at Huntington Lake.....	1,924 69
Filter at Kaweah Hatchery.....	466 15
Repairs and improvements at Mt. Shasta Hatchery.....	1,333 44
Permanent improvements on Snow Creek Hatchery.....	1,233 12
Total construction, improvements and equipment.....	\$12,498 24
License commissions.....	\$39,503 45
Purchase of game refuges.....	127,650 00
State Fair and other exhibits.....	5,183 81
Prior year expense—eighty-second fiscal year only.....	14,998 86
Grand total proprietary group.....	\$999,726 27

STATEMENT OF INCOME

For the Period July 1, 1931, to June 30, 1932, of the Eighty-third Fiscal Year

License sales	Detail	Total
Departmental income:		
Angling licenses, 1931	\$420,201 00	
Angling licenses, 1932	7,507 00	
Commercial hunting club licenses, 1931-32	1,375 00	
Commercial hunting club operator's licenses, 1931-32	345 00	
Deer tags, 1931	128,985 00	
Fish breeders' licenses, 1931	85 00	
Fish breeders' licenses, 1932	400 00	
Fish importers' licenses, 1931	15 00	
Fish importers' licenses, 1932	85 00	
Game breeders' licenses, 1931	130 00	
Game breeders' licenses, 1932	702 50	
Hunting licenses, 1931	397,473 40	
Hunting licenses, 1932	1,203 00	
Kelp licenses, 1931	10 00	
Market Fishermen's licenses, 1931-32	29,180 00	
Market Fishermen's licenses, 1932-33	230 00	
Trapping licenses, 1931-32	2,792 00	
Wholesale fish packers' and shell fish dealers' licenses, 1931-32	1,240 00	
Total license sales		\$991,958 90
Other income:		
Contributions from importers	30 00	
Court fines	46,654 88	
Fish packers' tax	67,750 97	
Fish tag sales	2,576 78	
Game tag sales	135 30	
Interest on bank balances	4,691 43	
Kelp tax	68 85	
Lease of kelp beds (kelco)	972 80	
Miscellaneous sales	588 25	
Total other income		123,469 26
Total departmental income		\$1,115,428 16
Income for the State University Fund:		
Kelp tax	\$35 01	\$35 01

CALIFORNIA FRESH FISHERY PRODUCTS FOR THE MONTHS OF JANUARY, FEBRUARY AND MARCH, 1932

Compiled by Division of Fish and Game, Bureau of Commercial Fisheries

Species of fish	Del Norte, Humboldt	Mendocino, Sonoma, Lake	Marin	Solano, Yolo	Sacramento, San Joaquin	Alameda, Contra Costa	San Francisco, San Mateo	Santa Cruz	Monterey
Anchovy							500	2,800	34,475
Barracuda								9	
Bonito									10
Cabrilla			153	474	2,903				
Carp		14,265		705	47,161	1,677			
Catfish						16,815			
Cultus		3,900						5,657	25,285
Flounder	46,859	3,285						10,345	78
Flying fish	13,502		22						
Hake									
Halibut									
Halibut—California									
Halibut—Northern	11,304	450					61	11,621	12,456
Hardhead		128,420					11,649		
Herring		700			1,712	20	238,975	58	17,423
Kelp Bass	5,271		207,450			64,130			
Kingfish							290	17,119	53,252
Mackerel—Horse									19,389
Mackerel—Pacific									21,027
Mackerel—Spanish									
Mullet									
Perch									
Pike	13,447		10,332				6,301	1,730	38,224
Pompano				60	694	601		26	135
Ray									
Rock Bass									
Rockfish	25,492	9,908					286,387	236,157	352,616
Sablefish	25,701	500					28,508	82,836	2,595
Salmon				7,061	20,156	17,960	60		830
Sand Dab	15,978	8,840					188,893		
Sardine							3,925,720	20,404	41,055,390
Sculpin		46					538	530	88

[illegible]

All amounts shown in pounds unless otherwise specified. Skipjack and Albacore cleaned.

CALIFORNIA FRESH FISHERY PRODUCTS FOR THE MONTHS OF JANUARY, FEBRUARY AND MARCH, 1932—Continued

Compiled by Division of Fish and Game, Bureau of Commercial Fisheries

Species of fish	San Luis Obispo, Santa Barbara, Ventura	Los Angeles	Orange	San Diego, Imperial	Total	Fish from south of the International Boundary brought into California via San Pedro	Fish from south of the International Boundary brought into California via San Diego	Total fish from south of the International Boundary brought into California
Anchovy		4,196			41,971	91,993	12,484	104,477
Barracuda	594	159,684	180	50,398	210,865	143		210,998
Bonito		28,723	451	2,137	31,321	8,442	73,410	81,852
Carbilla								
Carp								
Catfish								
Cutts		458	315	12	19,472			19,472
Flounder	196	190	72		64,681			64,681
Flying fish		55			225,024			225,024
Hake					313,521			313,521
Halibut					55			55
Halibut—California		6,040			10,033			10,033
Halibut—Northern	88,877	190,884	29,083	32,531	6,040	12	4,668	4,680
Hardhead					356,093			356,093
Herring					23,403			23,403
Kelp Bass	103			2,077	131,152			131,152
Kingfish		997			536,187			536,187
Mackerel—Horse	105	88,436	967	1,129	161,298			161,298
Mackerel—Pacific	398	98,501			117,890			117,890
Mackerel—Spanish		2,719,499	33,108	38,535	2,812,567			2,812,567
Mullet								
Perch			833			1,900		1,900
Pike	1,035	11,041	154	3,313	4,146		4,700	6,800
Pompano					88,264		2,755	2,755
Ray		584			1,361			
Rock Bass		255	41		780			
Rockfish	2,114	14,670	302		537			
Sablefish	18,552	711,973	6,138	40,944	63,886	672	804	1,476
Salmon		14,789	13,785	242,131	1,897,041		2,518	2,518
Sand Dab			2,010		156,940			
Sardine		1,795	37		45,237			
Sculpin	100	48,334,770		2,860	216,373			
Sea Bass—Black	762	7,443	2,347	6,884	93,339,144			
		25,802	4,025	108,290	138,904	42,947	46,788	89,735

Sea Bass—White	9,555	112,426	1,473	3,556	127,766	91	145	236
Shad	6,477	70,175	18,029	21,382	130,957			
Sheepshead	7,905	18,557	319	3,221	299,845		205	205
Skate		4,950	925	257	165,877			
Skipjack							297,728	297,728
Smelt	3,220	76,611	30	9,329	214,729			
Smelt—Jack	9,599	2,223			12,683			
Sole	41,612	14,668	1,231	1,198	2,022,360			
Spittail					14,220			
Striped Bass					195,498			
Sucker		103			7,693			
Swordfish—Broadbill					1,008			
Tom Cod					1,695			
Tuna—Yellowfin						437,493	1,121,596	1,559,089
Turbot					8,439			
Whitebait					33,752			
Whitefish	959	20,085	5	36,925	57,974		3,575	4,487
Yellowtail	165	174,087	901	12,103	187,256		39,045	56,517
Miscellaneous		6,412			22,759		9,370	9,370
Total fish	192,328	52,911,062	117,381	619,112	104,566,793	602,077	1,619,791	2,221,868
Crustaceans:								
Crab					918,783			
Shrimp					271,457			
Spiny Lobster	11,065	50,052	2,970	22,745	56,832	15,234	559,523	574,757
Mollusks:								
Abalone	30,420				192,220			
Clam—Hardshell		11,697			60,629			
Clam—Mixed	28	887			12,303			
Clam—Pismo					21,158			
Clam—Softshell	12,827				51,723			
Octopus		25			2,761			
Oyster—Eastern			10		98,116			
Oyster—Native					30,740			
Squid		141,293			187,477			
Totals	246,668	53,115,016	120,361	641,857	109,500,992	617,311	2,179,314	2,796,625

All amounts shown in pounds unless otherwise specified. Skipjack and Albacore cleaned.

ABSTRACT

CALIFORNIA SPORTING FISH AND GAME LAWS

VALID UNTIL 90 DAYS AFTER CLOSE OF 1933 LEGISLATURE

1931 OPEN AND CLOSED SEASONS 1932

WHITE SQUARES INDICATE OPEN SEASON. NUMBERS IN SQUARES ARE OPEN DATES

GAME	DISTRICTS	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	BAG AND POSSESSION LIMITS, ETC.
DEER	1½										15			No Does, Fawns or Spike Bucks No Forked Horned Deer in Dist. 14 No sale of Venison or Deer Skins Two Bucks per Season except in 13½ where limit is one See Notes 6-9-10-12
	2-2½-3									14				
	4-1½-4-4½-4¾-23 24-28									16	15			
Rabbits—Cottontail and Brush	ALL EXCEPT 4¾											15	15	15 per day. 30 per week. No limit in District 4 No protection in 4¾
Bear, Fur Animals	ALL											15		See Note 7 Predatory animals unprotected in districts 2-2½-3-4-4½
Ducks, Geese, Jack Snipe, Mud Hens	FEDERAL LAW ALL STATE LAW										OPEN NOON OCT. 1			15 Ducks, 30 in Possession; 4 Geese, 8 in Possession; 20 Snipe, 25 Mud Hens, No Ross Snipe or Cackling Geese 25 Ducks, 25 Snipe, 25 Mud Hens. 50 Per Week Goose Limit See Note 4. See Notes 9-10-11-12-13
Quail—Valley, Desert and Mountain	ALL EXCEPT 1½ 1½											15	15	Valley and Desert 15 per day. 30 per week Mountain 10 per day. 20 per week
Dove	ALL EXCEPT 4-4½-4¾													Federal Season Opens Nov. September 1
	4-4½-4¾													15 per day 30 per week

There is no open season on Elk, Antelope, Mountain Sheep, Sea Otter, Tree Squirrel, Sierra Hare, Rail, Wood Duck, Pigeon, Swan, Shore Birds (except Jack Snipe), Grouse, Sage Hen, Imported Quail, Wild Pheasant, Partridge, or Wild Turkey.

FISH	DISTRICTS	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	BAG AND POSSESSION LIMITS, ETC.
Steelhead and all Trout (except Golden), Whitefish Unlawful to take trout in waters closed by Gov- ernor's proclamation	1-1½-1¾-2-3-4-4½-4¾-15 Klamath River, Lake Almanor													No Sale No Sparring For other restrictions See Notes 12-15-16-20 21-22-28-29 31-33 On this Card
	2½		28			30								
	23-24-25					30								
	Truckee River					15								
Golden Trout	See Note 22													5 Trout regardless of weight
	1½ Winter Klamath River Russian, Navarro, Napa and Eel (Dist. 2) In water Dist. 2-3-15													
BLACK BASS	ALL EXCEPT 4¾ CLEAR LAKE IN LAKE CO.													20 per day. None under 5 inches Not more than 10 lbs. and one
Sunfish	ALL													15 per day in Clear Lake 10 per day No Black Bass under 9 lbs. No sale Hook and line only
Sacramento Perch and Crappie	ALL EXCEPT CLEAR LAKE CLEAR LAKE													25 per day Hook and line only No sale
Striped Bass	1-3-12A													10 per day None under 12 inches, 5 per day. None to be taken from Solano Sea. See Note 19 See Note 24, None under 7 inches. No Female
Crabs	ALL EXCEPT 1½-6-7-8-9							30				15		Only for food. Must be brought to shore alive in shell Anyling License Required. See Note 27
Abalones	ALL	14			16									None under 5 inches. No shipment. 15 per day Anyling License Required. District 18a Closed
Pismo Clams	17													No Sale of Mussel. None under 10½ or over 10 inches See Note 24
Spiny Lobster	ALL										15			
GRUNION	ALL													

Salmon and Shad May Be Taken as Noted in Paragraphs 19-23. No open season on Sturgeon (possession prohibited).

NOTES

IT IS ALWAYS UNLAWFUL

1. To hunt, kill, possess wild birds or mammals, to possess firearms, except under written permit from the Commission, within districts 1a, 1b, 1c, 1d, 1e, 1f, 1g, 1h, 1i, 1j, 1k, 1m, 1n, 1o, 1p, 1q, 1r, 1s, 1t, 2a, 2b, 2c, 2d, 2e, 2f, 2g, 2h, 2i, 2j, 2k, 2l, 2m, 2n, 2o, 2p, 2q, 2r, 2s, 2t, 2u, 2v, 2w, 2x, 2y, 2z, 3a, 3b, 3c, 3d, 3e, 3f, 3g, 3h, 3i, 3j, 3k, 3l, 3m, 3n, 3o, 3p, 3q, 3r, 3s, 3t, 3u, 3v, 3w, 3x, 3y, 3z, 4a, 4b, 4c, 4d, 4e, 4f, 4g, or General Grant Refuge, or the Mt. Tamalpais Game Refuge, including Richardson Bay, or San Francisco Refuge, or Silver Lake Refuge (water fowl may be killed in 4a and 4e), or to hunt quail in the Bolinas Quail Refuge, or to hunt or discharge firearms in Huntington Lake Refuge or San Leandro Bay Refuge.

2. To hunt birds or mammals excepting predators without a hunting license.

3. To possess any bird net or to net, trap or to hold protected game or birds of any kind, their nests or eggs except under written permit from the Commission.

4. To take or possess more than 8 geese per day or 50 per week; or more than 8 honkers or sea brant per day or 24 per week.

5. To take or kill non-game birds, except blue jay, butcher bird, English sparrow, sharp-shinned, Cooper or duck hawk, great horned owl, linnet, white pelican, shag, and in districts 1, 2, 3, 4 and 4½, blackbirds.

6. To hunt deer without a deer tag license. To fail to attach to the horns of deer immediately on killing, properly filled out license tag or at the same time to send duplicate tag to the Division. To carry a deer into a closed district without having license tag countersigned, or to have untagged deer in possession. To fail to retain in possession during open season and for ten days after the skin and portion of head bearing horns of deer killed and to produce upon demand. To use more than one dog to the hunter in hunting deer or to allow dogs to run deer in closed season, or to possess doe or fawn skins, or deer skins not bearing evidence of sex.

7. To trap for profit bear, ring-tailed cat, coon, pine marten, skunk, fisher, wolverine, mink, river otter, fox, beaver or muskrat, or to kill these animals during the closed season, except when destroying property. To interfere with the traps of licensed trappers. To use saw tooth or spike jawed traps for taking fur bearers.

8. To use any animal other than a dog to stalk wild birds.

9. To shoot game from a power boat, sailboat, auto, airplane; or to hunt waterfowl from a scull boat in districts 8, 9, except on Wednesdays and Sundays, or at any time in district 12 or Napa River south of Edgerly Island, or to use a

shotgun larger than ten gauge, or to possess an extension automatic or a cane gun.

16. To shoot resident game between 1 hour after sunset and 1 hour before sunrise, or migratory game between sunset and 1 hour before sunrise. To use a spotlight in hunting game.

17. To hunt waterfowl in districts 4, 4A, 4B, 19, 20, 20A, 22, other than on Wednesdays, Saturdays, Sundays, legal holidays, opening and closing days; or in district 4A except between 8 a.m. and sunset. To drive game birds by means of auto, airplane, or power boat over shooters.

18. To hold game or fish longer than 5 days after close of season, venison 15 days.

19. To sell wild game, except cottontail and brush rabbits.

20. To make a false statement in applying for license. To fail to show license upon demand to any officer.

21. To take game or fish from one district to another when season is not open in both. (Special law for deer and trout.) Trout legally taken may be transported from an open district into a closed district by the consignor making an affidavit in duplicate setting forth his name, address, number of angling license and name and address of consignee. The original must be attached to the shipment, the copy left on file with the officer before whom sworn. Trout may be shipped into closed district when accompanied by written statement to the effect that trout were legal, signed by shipper, countersigned by agent to whom offered for shipment.

22. To ship wild birds, mammals, or fish except smoked or dried fish other than trout by parcel post, or in concealed packages or without a tag bearing name and address of consignee and consignor and contents, or to ship game out of state.

23. To operate a commercial hunting club without license.

24. To place obstructions in streams in districts 1, 1A, 2, 2A, 3, 4, 4A, 23, 24, and 25 that will stop or impede fish.

25. To buy, sell or ship striped bass less than 20 inches in length, or to ship striped bass out of state, or to ship striped bass during closed season; to take other than with hook and line. To possess more than five shad per day between May 16 and July 31, or September 17 and November 14.

26. To take more than with rod and line held in the hand or with lure with more than 2 attractor blades or more than 3 hooks.

27. To have in possession any fish spear or gaff (except landing gaff) within 300 feet of any lake or stream when unlawful to spear salmon.

28. To take trout in any lake within 300 feet of the mouth of any stream from October 31 to August 1, or in that portion of any stream flowing into any lake in Districts 23 and 24 within two miles from its mouth, upstream, from October 31 to August 1.

29. To take salmon on spawning beds or within 10 miles of a spawning station or 3 miles north and south of mouth of Klamath River; to take in ocean and Humboldt Bay districts Chinook less than 27, or Silver less than 24 inches, or to gaff or club underized salmon, or to bring ashore in such condition that the size can not be taken, or to not have a landing

net in any salmon boat. To take more than 2 salmon per day in districts 1, 1A, 2, 2A, Klamath River (above tidewater), 3, 12A, Klamath River (below tidewater) except between July 1-September 6; to spear salmon except in districts 1, 1A, 2, 2A, Klamath River above tidewater; to take salmon in any way except between dates given—district 1 May 23-October 31; 1A, Klamath River May 23-December 31; 2, 2A, May 1-February last; 3, 12A May 1-October 31; to take or possess salmon except between dates given—districts 6, 7, 8, 9, May 1-September 15; districts 10, 11, May 1-August 15; districts 15, 16, 17, 18, April 1-June 30; to spear salmon except between dates given—district 1 May 23-October 31; 1A and Klamath River above tide August 1-October 31; 2, 2A November 1-February last.

30. To bring to shore crabs or lobsters in such condition that the size can not be taken; or to ship or carry crabs out of districts 1, 1A, 2, 2A, 3, 4, 4A, 6, 7, 8, or 9.

31. To take or possess in district 3 salt water eels of less than 12 inches or more than 15 per day.

32. To take or possess cockles less than 11 inches in diameter, or to take or possess more than 15 (Dist. 10) Washington clams or more than 10 horse clams or more than 15 pounds of mussels per day, or in districts 18, 19, 21 more than 15 pounds of mussels per day.

33. To take red abalones less than 7 inches in the greatest diameter; green, 6 1/2; pink, 6; black, 5; to dry abalones; to dive for abalones in districts 7, 15, 16, 17, 19, 20 and 20A; to take more than 10 per day or 20 per week in districts 7, 15, 16, 17, 19, 20 and 20A. To take more than 10 per day from shore in districts 7, 10 and 18; to take more than 10 black abalones per day in districts 14, 15, 17, 18, 19, 20, 20A, 21.

34. To fish for game fish without having an angling license.

35. To take game fish between 1 hour after sunset and 1 hour before sunrise in districts 1, 1A, 1B, 2, 2A, 3, 4, 4A, 4B, 23, 24, 25.

36. To fish with nets except in commercial districts.

37. To fish through the ice for any fish or to take fish in district 14.

38. To place, cause to be placed, or discharge into any waters substances deleterious to fish or plant life.

39. To fish within 250 feet of a fishway or 150 feet of the upper side of a fish screen, or the lower side of a dam, or to take fish except salmon within 1/2 mile of the lower side of a spawning station, or any lake within 1/2 mile of a spawning station when station is in operation.

40. To kill, injure or capture California sea lions in districts 19, 20, 20A.

41. To take invertebrates or marine plants in Hopkins Marine Refuge (Monterey Co.) or in that area between the west line of the property of the Scripps Institution and a line 1,000 feet west of low tide line (San Diego Co.).

42. To take more than 5 white sea bass from May 1 to June 30, or to take at any time more than 5 under 28 inches.

43. To take more than 30 pounds of halibut under 4 pounds each, or to take more than 6 barracuda less than 3 pounds each.

LICENSES MUST BE SHOWN UPON DEMAND

Districts 1A, 1B, 1C, 1D, 1E, 1F, 1G, 1H, 1I, 1J, 1K, 1L, 1M, 1N, 1O, 1P, 1Q, 1R, 1S, 1T, 1U, 1V, 1W, 1X, 1Y, 1Z, 2A, 2B, 2C, 2D, 2E, 2F, 2G, 2H, 2I, 2J, 2K, 2L, 2M, 2N, 2O, 2P, 2Q, 2R, 2S, 2T, 2U, 2V, 2W, 2X, 2Y, 2Z, 3A, 3B, 3C, 3D, 3E, 3F, 3G, 3H, 3I, 3J, 3K, 3L, 3M, 3N, 3O, 3P, 3Q, 3R, 3S, 3T, 3U, 3V, 3W, 3X, 3Y, 3Z, 4A, 4B, 4C, 4D, 4E, 4F, 4G, 4H, 4I, 4J, 4K, 4L, 4M, 4N, 4O, 4P, 4Q, 4R, 4S, 4T, 4U, 4V, 4W, 4X, 4Y, 4Z, 5A, 5B, 5C, 5D, 5E, 5F, 5G, 5H, 5I, 5J, 5K, 5L, 5M, 5N, 5O, 5P, 5Q, 5R, 5S, 5T, 5U, 5V, 5W, 5X, 5Y, 5Z, 6A, 6B, 6C, 6D, 6E, 6F, 6G, 6H, 6I, 6J, 6K, 6L, 6M, 6N, 6O, 6P, 6Q, 6R, 6S, 6T, 6U, 6V, 6W, 6X, 6Y, 6Z, 7A, 7B, 7C, 7D, 7E, 7F, 7G, 7H, 7I, 7J, 7K, 7L, 7M, 7N, 7O, 7P, 7Q, 7R, 7S, 7T, 7U, 7V, 7W, 7X, 7Y, 7Z, 8A, 8B, 8C, 8D, 8E, 8F, 8G, 8H, 8I, 8J, 8K, 8L, 8M, 8N, 8O, 8P, 8Q, 8R, 8S, 8T, 8U, 8V, 8W, 8X, 8Y, 8Z, 9A, 9B, 9C, 9D, 9E, 9F, 9G, 9H, 9I, 9J, 9K, 9L, 9M, 9N, 9O, 9P, 9Q, 9R, 9S, 9T, 9U, 9V, 9W, 9X, 9Y, 9Z, 10A, 10B, 10C, 10D, 10E, 10F, 10G, 10H, 10I, 10J, 10K, 10L, 10M, 10N, 10O, 10P, 10Q, 10R, 10S, 10T, 10U, 10V, 10W, 10X, 10Y, 10Z, 11A, 11B, 11C, 11D, 11E, 11F, 11G, 11H, 11I, 11J, 11K, 11L, 11M, 11N, 11O, 11P, 11Q, 11R, 11S, 11T, 11U, 11V, 11W, 11X, 11Y, 11Z, 12A, 12B, 12C, 12D, 12E, 12F, 12G, 12H, 12I, 12J, 12K, 12L, 12M, 12N, 12O, 12P, 12Q, 12R, 12S, 12T, 12U, 12V, 12W, 12X, 12Y, 12Z, 13A, 13B, 13C, 13D, 13E, 13F, 13G, 13H, 13I, 13J, 13K, 13L, 13M, 13N, 13O, 13P, 13Q, 13R, 13S, 13T, 13U, 13V, 13W, 13X, 13Y, 13Z, 14A, 14B, 14C, 14D, 14E, 14F, 14G, 14H, 14I, 14J, 14K, 14L, 14M, 14N, 14O, 14P, 14Q, 14R, 14S, 14T, 14U, 14V, 14W, 14X, 14Y, 14Z, 15A, 15B, 15C, 15D, 15E, 15F, 15G, 15H, 15I, 15J, 15K, 15L, 15M, 15N, 15O, 15P, 15Q, 15R, 15S, 15T, 15U, 15V, 15W, 15X, 15Y, 15Z, 16A, 16B, 16C, 16D, 16E, 16F, 16G, 16H, 16I, 16J, 16K, 16L, 16M, 16N, 16O, 16P, 16Q, 16R, 16S, 16T, 16U, 16V, 16W, 16X, 16Y, 16Z, 17A, 17B, 17C, 17D, 17E, 17F, 17G, 17H, 17I, 17J, 17K, 17L, 17M, 17N, 17O, 17P, 17Q, 17R, 17S, 17T, 17U, 17V, 17W, 17X, 17Y, 17Z, 18A, 18B, 18C, 18D, 18E, 18F, 18G, 18H, 18I, 18J, 18K, 18L, 18M, 18N, 18O, 18P, 18Q, 18R, 18S, 18T, 18U, 18V, 18W, 18X, 18Y, 18Z, 19A, 19B, 19C, 19D, 19E, 19F, 19G, 19H, 19I, 19J, 19K, 19L, 19M, 19N, 19O, 19P, 19Q, 19R, 19S, 19T, 19U, 19V, 19W, 19X, 19Y, 19Z, 20A, 20B, 20C, 20D, 20E, 20F, 20G, 20H, 20I, 20J, 20K, 20L, 20M, 20N, 20O, 20P, 20Q, 20R, 20S, 20T, 20U, 20V, 20W, 20X, 20Y, 20Z, 21A, 21B, 21C, 21D, 21E, 21F, 21G, 21H, 21I, 21J, 21K, 21L, 21M, 21N, 21O, 21P, 21Q, 21R, 21S, 21T, 21U, 21V, 21W, 21X, 21Y, 21Z, 22A, 22B, 22C, 22D, 22E, 22F, 22G, 22H, 22I, 22J, 22K, 22L, 22M, 22N, 22O, 22P, 22Q, 22R, 22S, 22T, 22U, 22V, 22W, 22X, 22Y, 22Z, 23A, 23B, 23C, 23D, 23E, 23F, 23G, 23H, 23I, 23J, 23K, 23L, 23M, 23N, 23O, 23P, 23Q, 23R, 23S, 23T, 23U, 23V, 23W, 23X, 23Y, 23Z, 24A, 24B, 24C, 24D, 24E, 24F, 24G, 24H, 24I, 24J, 24K, 24L, 24M, 24N, 24O, 24P, 24Q, 24R, 24S, 24T, 24U, 24V, 24W, 24X, 24Y, 24Z, 25A, 25B, 25C, 25D, 25E, 25F, 25G, 25H, 25I, 25J, 25K, 25L, 25M, 25N, 25O, 25P, 25Q, 25R, 25S, 25T, 25U, 25V, 25W, 25X, 25Y, 25Z.

Districts 5, 6, 7, 8, 9, 10, 11, 12, 13A, 13B, 13C, 13D, 13E, 13F, 13G, 13H, 13I, 13J, 13K, 13L, 13M, 13N, 13O, 13P, 13Q, 13R, 13S, 13T, 13U, 13V, 13W, 13X, 13Y, 13Z, 14A, 14B, 14C, 14D, 14E, 14F, 14G, 14H, 14I, 14J, 14K, 14L, 14M, 14N, 14O, 14P, 14Q, 14R, 14S, 14T, 14U, 14V, 14W, 14X, 14Y, 14Z, 15A, 15B, 15C, 15D, 15E, 15F, 15G, 15H, 15I, 15J, 15K, 15L, 15M, 15N, 15O, 15P, 15Q, 15R, 15S, 15T, 15U, 15V, 15W, 15X, 15Y, 15Z, 16A, 16B, 16C, 16D, 16E, 16F, 16G, 16H, 16I, 16J, 16K, 16L, 16M, 16N, 16O, 16P, 16Q, 16R, 16S, 16T, 16U, 16V, 16W, 16X, 16Y, 16Z, 17A, 17B, 17C, 17D, 17E, 17F, 17G, 17H, 17I, 17J, 17K, 17L, 17M, 17N, 17O, 17P, 17Q, 17R, 17S, 17T, 17U, 17V, 17W, 17X, 17Y, 17Z, 18A, 18B, 18C, 18D, 18E, 18F, 18G, 18H, 18I, 18J, 18K, 18L, 18M, 18N, 18O, 18P, 18Q, 18R, 18S, 18T, 18U, 18V, 18W, 18X, 18Y, 18Z, 19A, 19B, 19C, 19D, 19E, 19F, 19G, 19H, 19I, 19J, 19K, 19L, 19M, 19N, 19O, 19P, 19Q, 19R, 19S, 19T, 19U, 19V, 19W, 19X, 19Y, 19Z, 20A, 20B, 20C, 20D, 20E, 20F, 20G, 20H, 20I, 20J, 20K, 20L, 20M, 20N, 20O, 20P, 20Q, 20R, 20S, 20T, 20U, 20V, 20W, 20X, 20Y, 20Z, 21A, 21B, 21C, 21D, 21E, 21F, 21G, 21H, 21I, 21J, 21K, 21L, 21M, 21N, 21O, 21P, 21Q, 21R, 21S, 21T, 21U, 21V, 21W, 21X, 21Y, 21Z, 22A, 22B, 22C, 22D, 22E, 22F, 22G, 22H, 22I, 22J, 22K, 22L, 22M, 22N, 22O, 22P, 22Q, 22R, 22S, 22T, 22U, 22V, 22W, 22X, 22Y, 22Z, 23A, 23B, 23C, 23D, 23E, 23F, 23G, 23H, 23I, 23J, 23K, 23L, 23M, 23N, 23O, 23P, 23Q, 23R, 23S, 23T, 23U, 23V, 23W, 23X, 23Y, 23Z, 24A, 24B, 24C, 24D, 24E, 24F, 24G, 24H, 24I, 24J, 24K, 24L, 24M, 24N, 24O, 24P, 24Q, 24R, 24S, 24T, 24U, 24V, 24W, 24X, 24Y, 24Z, 25A, 25B, 25C, 25D, 25E, 25F, 25G, 25H, 25I, 25J, 25K, 25L, 25M, 25N, 25O, 25P, 25Q, 25R, 25S, 25T, 25U, 25V, 25W, 25X, 25Y, 25Z.

District 24 includes waters in watershed of Coconino above mother lode highway bridge, waters of South Fork American River between Chilli Bar Bridge and mouth of Silver Creek; the waters of the Carson, West Carson and all tributaries, Twin Lakes, Silver, Twin, Blue, Meadow, Wood, Winnemucca, Scott, Burnside Lake and all tributary streams.

District 23 includes waters in watershed of Coconino above mother lode highway bridge, waters of South Fork American River between Chilli Bar Bridge and mouth of Silver Creek; the waters of the Carson, West Carson and all tributaries, Twin Lakes, Silver, Twin, Blue, Meadow, Wood, Winnemucca, Scott, Burnside Lake and all tributary streams.

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LICENSE PROVISIONS

HUNTING

License year after July, 1931, July 1 to June 30	
Residents under 18	\$1.00
Residents citizens	2.00
Non-resident citizens	10.00
Declarant Aliens	10.00
Other Aliens	25.00

On account of change in hunting license year, cost of license from January 1, 1932, to June 30, 1933 (18 months), will be 1 1/2 times above schedule.

ANGLING

License year January 1 to December 31	
Residents citizens	\$2.00
Non-resident citizens	5.00
Aliens	5.00
Under 18 no license required	

TRAPPING

License year July 1 to June 30	
Citizens	\$1.00
Non-resident citizens	2.00
Under 18 no license required	

DEER TAG

License year January 1 to December 31	
Everyone (2 tags)	\$1.00

COMMERCIAL HUNTING CLUBS

License year July 1 to June 30	
Citizens	\$25.00
Aliens	100.00
Operators, citizens	5.00
Operators, aliens	25.00

For Laws in Full See Penal Code.

For Commercial Fish Laws See Commercial Abstract.

For Information Regarding Fish or Game Write to the Division of Fish and Game

